

# CONCRETE AND CONSTRUCTIONAL ENGINEERING

INCLUDING PRESTRESSED CONCRETE

APRIL, 1953.



Vol. XLVIII, No. 4

FORTY-EIGHTH YEAR OF PUBLICATION

PRICE 1s. 6d.

ANNUAL SUBSCRIPTION 18s., POST FREE. \$3.90 in Canada and U.S.A.

## LEADING CONTENTS

	PAGE
Shearing Stresses in Reinforced Concrete . . . . .	129
Continuous Beams on Wide Supports. <i>By Albin Chronowicz</i> .	131
Ultimate Strength of Prestressed Beams. <i>By Professor A. L. L. Baker, Donovan Lee, and Professor G. Magnel</i> . . . . .	142
Foundation for a Large Hammer. <i>By Rolt Hammond</i> . . . . .	145
Factory for Prestressed Concrete in Argentina . . . . .	153
Prefabricated Reinforcement . . . . .	158

No. 545.

ISSUED MONTHLY

*Registered for  
Canadian Magazine Post*

## BOOKS ON CONCRETE

For catalogue of "Concrete Series" books on concrete and allied subjects, send a postcard to:

CONCRETE PUBLICATIONS LTD., 14 DARTMOUTH ST., LONDON, S.W.1



*For over 60 years*

this trade mark has stood for speed and  
strength in reinforced concrete work.

# DRAGON

(Brand)

## PORTLAND CEMENT

*Supplied by*

THE SOUTH WALES PORTLAND CEMENT & LIME CO. LTD.  
PENARTH, SOUTH WALES

Telephone : Penarth 300

Telegrams : "Cement, Penarth"

# Burton's

(SAFETY LOCK—UNIQUE FEATURE)

## TUBULAR STEEL PROPS (ADJUSTABLE)

*For Supporting Temporary Floor Shuttering*

### Burton's Adjustable Tubular Steel Props

for the above and many other purposes, are much preferred by the men who erect them to the old-fashioned Timber Props. They can be erected by one man in a few minutes and positively adjusted and **safely locked** in position, thus avoiding any possibility of being accidentally or maliciously tampered with.

*Manufactured in our own most modern and up-to-date works at Old Hill, Staffs.*

No spanner, jack, or tommy bar necessary; simply lift inner tube, insert peg, and tighten up.

*No loose parts to lose, and easily transported.*

### BURTON'S ADJUSTABLE TUBULAR STEEL BEAM PROPS

are provided, as illustrated, with a braced head for supporting temporary shuttering to R.S.J. casings and reinforced concrete beams, &c.



Size No.	HEIGHT		Approx. Weight each in Lbs.
	Fully Closed	Fully Extended	
1.	5 ft. 7 in.	9 ft. 10 in.	50
2.	6 ft. 7 in.	10 ft. 10 in.	54
3.	8 ft. 2½ in.	12 ft. 5½ in.	58
4.	11 ft. 0 in.	16 ft. 0 in.	72

*Head Fittings to suit any Special Job, designed for use with BURTON'S PROPS.*

## Burton's Patent Solid Dropforged Steel Scaffolding Fittings

## THE LONDON & MIDLAND STEEL SCAFFOLDING CO., LTD.

ST. LUKE'S WORKS, OLD HILL, STAFFORDSHIRE

Telegrams: DUBELGRIP, CRADLEY HEATH.

Telephone: CRADLEY HEATH 6237/8

London Offices: BURWOOD HOUSE, CAXTON STREET, S.W.1

Telephone: Abbey 6483/4

Telegrams: Dubelgrip, Sowest, London

# POWER BAR BENDERS

## FOR ALL SIZES OF REINFORCING BARS

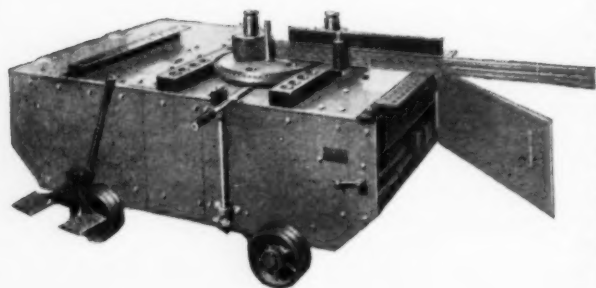
### STANDARD PRODUCTION MODELS

The ARD. 50 MODEL—as illustrated on right—has a capacity for cold bending Mild Steel Bars up to 2" dia. and incorporates a second Bending Head to give high-rate bending for small diameter bars.

The RAS. 40 MODEL shown below is a single disc machine of exceptional performance. With a capacity for 1½" dia. bars, it bends at highest practical rate—e.g. a full hook takes only 3 seconds bending time.



*Ensure accuracy, economy  
& simplicity of operation*



### INTERESTING FEATURES

Either of the Models illustrated can be supplied motorised or engine driven.

Standard Accessories supplied include all necessary Formers and Bending Pins, a special Backrest for simultaneous bending of a number of small diameter bars, and Accessories for forming right-angle loops in one operation.

Special Safety Device incorporated to prevent damage to mechanism if overloaded.

The desired Bending Angle may be set mathematically, and this is of great assistance in Repetition Bending.

# CEMENT & STEEL LTD.

SECOND AVENUE

CHATHAM

KENT

Telephone: Chatham 45580

Telegrams and Cables: Cembelgi, Chatham



Determining the cover of reinforcement, or the position of prestressing cables, immediately the concrete is placed avoids risk of unsafe structures . . .

•  
•



The following is an extract from a letter received from a user of the C. & C.A. Covermeter regarding the illustration shown above—"I enclose a print of a reinforced concrete cantilever step that failed due to incorrect positioning of the reinforcing steel. Being one of a long double-flight staircase, concern was felt for the safety of the other steps. The Covermeter was used, and they were all found to be unsafe in various degrees, necessitating cutting out and renewing. The new steps were checked by Covermeter before being built in."



## C. & C.A. COVERMETER

The Cement and Concrete Association Covermeter, illustrated above, has been specially produced to provide an easy, accurate, and economical means of finding the exact cover of reinforcement bars, or the position of prestressing cables, without interfering with the concrete and before the concrete has hardened. It thus enables Reinforced Concrete Engineers to make sure that the specified cover of reinforcement is maintained throughout the structure, and that the position of prestressing cables is in accordance with the design. It can also be used to find the position of reinforcement, gas pipes, and other fittings in existing structures. The C. & C.A. Covermeter can be supplied for Metric or Imperial systems of measurements. For full details and prices, send to the manufacturers:

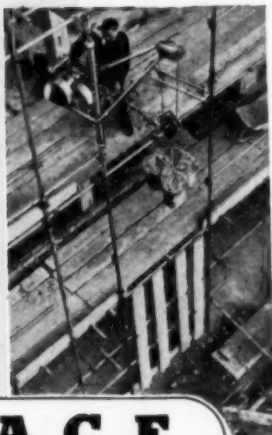
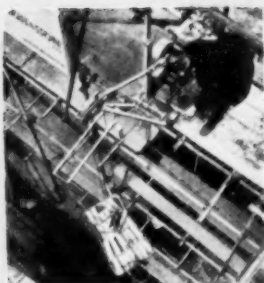
**B. & P. RADIOS LIMITED**

(ELECTRONIC DIVISION), LANGHAM PARADE, LONDON, N.15. Tel.: Bowes Park 7140



# MIDGET HOIST

*Saves time and money  
on every kind of contract*

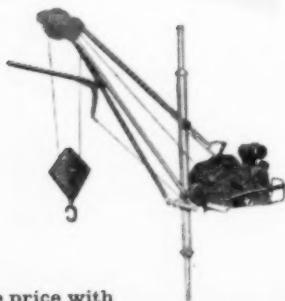


## ACE

PLATFORM HOISTS-WINCHES

# 12

## TRUMP POINTS!



- ♠ ACE Low purchase price with negligible running and maintenance costs
  - ♠ ACE Easy to install and easy to move to other locations
  - ♠ ACE 5 cwt. capacity to handle barrow loads, beams, lintels, etc.
  - ♠ ACE Faster speeds for triple bucket duty and lighter loads
  - ♠ ACE Adjustable radius up to 5 ft.
  - ♠ ACE ACE top trip prevents overwinding
  - ♠ ACE Winch quickly detachable from jib for separate use if required
  - ♠ ACE Snap action hook for changeover of rope reeve, dismantling or assembly
  - ♠ ACE Load taken on 4 scaffold tubes increases safety
  - ♠ ACE Built to last
  - ♠ ACE Petrol or electric drive
  - ♠ ACE PROMPT DELIVERY
- Write for illustrated leaflet  
Demonstrations can be arranged

ACE MACHINERY LTD., PORDEN ROAD, BRIXTON, LONDON, S.W.2  
Telephone: BRIXTON 3293 (9 lines) And at Brentford

**Buy ACE and you buy RELIABILITY**

# DOUGLAS

RIVERSLEY PARK

NUNEATON



G. ASHTON, A.M.I.C.E., M.I.Mun.E.,  
*Borough Engineer.*

MAGNEL-BLATON EQUIPMENT  
SUPPLIED BY  
STRESSED CONCRETE DESIGN, LTD.

**first prestressed bridge  
in the Midlands  
SPAN 60 ft.**

---

ROBERT M. DOUGLAS (CONTRACTORS) LTD.  
395 GEORGE RD., BIRMINGHAM, 23. AND BRIDGE RD., WAUNARLWYDD, nr. SWANSEA.

---

**TO ALL WHO HIRE STEEL SHUTTERING  
'H' FRAMES AND PROPS**

**Make**  
**MILLS**  
**your *buyword* for**  
**economy**

**OWN A STOCK OF MILLFORMS, MILLFRAMES  
AND MILLPROPS AND SAVE YOURSELF MONEY**



**AS WELL AS CONTRACT TIME**

MILLFORMS (the automatically aligning and self-supporting steel shuttering for concrete walls, floors, columns and beams), MILLFRAMES (the greatest single time-and-labour-saving advance in tubular scaffolding technique) and MILLPROPS (adjustable tubular steel shores) are the finest stock investments you can make. They save you money every time you use them—and you save more when you own them. Write for full details now.

**MILLS SCAFFOLD CO. LTD.**

(A Subsidiary of Guest, Keen & Nettlefolds, Ltd.)

Head Office: **TRUSSLEY WORKS, HAMMERSMITH GROVE, LONDON, W.6 • R1Verside 5026/9**

**Agents and Depots:** BELFAST • BIRMINGHAM • BOURNEMOUTH • BRIGHTON • BRISTOL  
CANTERBURY • CARDIFF • COVENTRY • CROYDON • DUBLIN • GLASGOW • HULL • ILFORD  
LIVERPOOL • LOWESTOFT • MANCHESTER • NEWCASTLE • NORWICH • PLYMOUTH  
PORTSMOUTH • READING • SHIPLEY • SOUTHAMPTON • SWANSEA • YARMOUTH

# PILING

We have a range of the most up-to-date piling plants in this country capable of handling reinforced concrete piles up to 95 ft. in length and 13 tons in weight. To drive the piles steam hammers are used of which the largest weigh  $6\frac{1}{2}$  tons.

Several of these plants are power driven in every motion, can rotate to face in any direction, and are particularly suited to drive raking piles as they can vary their batter from 1 in  $2\frac{1}{2}$  backward to 1 in 6 forward.

When mounted on travelling undercarriages up to 150 ft. in length our piling plants can operate over large areas with speed and efficiency.

## PETER LIND & CO. LTD

BUILDING AND CIVIL ENGINEERING CONTRACTORS

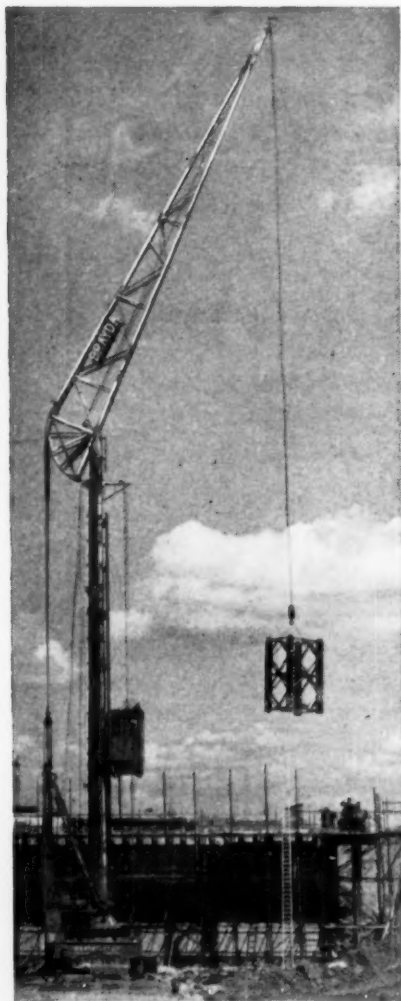
STRATTON HOUSE, PICCADILLY, LONDON, W.1

TELEPHONE: GROSVENOR 4601 (10 LINES)

## *Revolutionary Developments*

# BRAYDA

## ELECTRIC TOWER CRANE



### *Reduced Handling Costs & Manpower*

PORTABLE · QUICKLY ERECTED & DISMANTLED

This new electric tower crane offers many advantages in methods of mechanical handling. With its great height and long reach many jobs executed by motorised equipment or manual labour can be handled quicker and easier by the BRAYDA with a marked saving in handling costs.

- At a radius of 20 feet the BRAYDA can lift 3 tons 9 cwt. to a height of 123 feet.
- At a maximum radius of 65 feet the BRAYDA can lift 29.5 cwt. to a height of 75 feet.
- Can operate in close proximity to walls—framework, etc. Turning radius of 11½ feet inside track.
- All operations controlled from driver's cab which can be raised or lowered as required.

A FEW OF THE MANY USES OF THE BRAYDA TOWER CRANE:— CONSTRUCTION OF BLAST FURNACES AND STORAGE TANKS; LOADING AND UNLOADING OF SHIPS, BARGES AND TRUCKS; STACKING MATERIAL INCLUDING TIMBER, STEEL, DRUMS, CRATES, BAGS, ETC.; LOADING INTO HOPPERS, MIXERS AND WAGONS; ERECTION OF HOUSES, FLATS, OFFICES, FACTORIES, HANGARS, ETC.

LOOK TO BRAY FOR NEW DEVELOPMENTS  
AND CONTINUED LEADERSHIP

**W · E · BRAY & CO · LTD ·**

FELTHAM · MIDDLESEX · PHONE FELTHAM 3471-2-3-4





*founded on*  
**FRANKIPILES**

Westfield Court,  
Gorgie, Edinburgh

Consulting Engineers :  
Messrs. Kinnear and Gordon

## **FRANKIPILE**

(THE FRANKI COMPRESSED PILE CO. LTD.)

**39 Victoria Street,  
London, S.W.1**

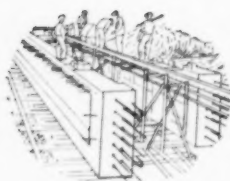
Telephone : ABBey 6006-9      'Grams : Frankipile Sowest London

And in  
AUSTRALASIA  
BRITISH WEST INDIES AND SOUTH AFRICA

---



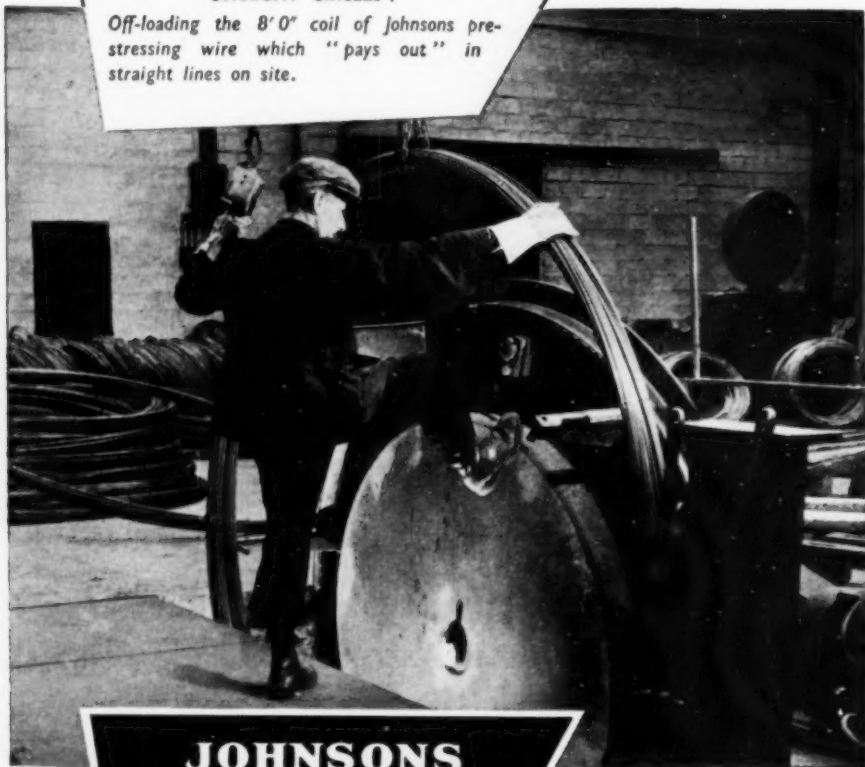
## *The answer to the steel problem*



Steel shortages present another opportunity to show concrete's versatility—prestressed concrete is the latest example. Remember, however, the added strength lies in the high tensile wire within the concrete. And remember, also, that wire made by JOHNSONS has set the standard of efficiency since its use in the first of Britain's prestressed concrete bridges. First with so many developments, Johnsons again led the way with 8' 0" coils and indented wire.

### STRAIGHT CIRCLES !

Off-loading the 8' 0" coil of Johnsons prestressing wire which "pays out" in straight lines on site.



# **JOHNSONS WIRE . . .**

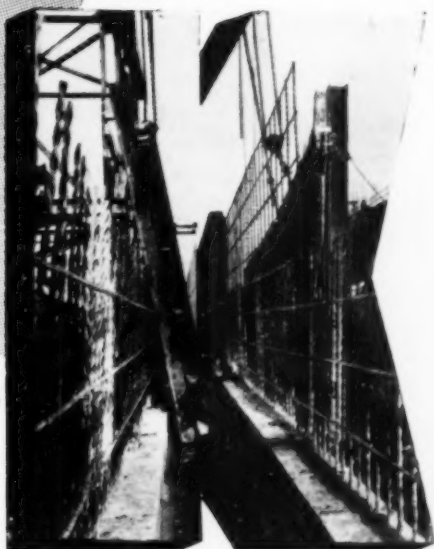
FOR THE CONCRETE  
INDUSTRY

SEE OUR STAND, B417-322, B.I.F., BIRMINGHAM

RICHARD JOHNSON & NEPHEW LTD. FORGE LANE MANCHESTER 11



## REINFORCED CONCRETE CONSTRUCTION



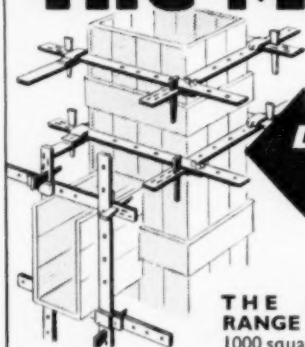
HEAVY REINFORCED  
CONCRETE RETAINING WALL IN  
COURSE OF CONSTRUCTION



**UNITED KINGDOM CONSTRUCTION  
& ENGINEERING COMPANY LTD..**

CIVIL ENGINEERING CONTRACTORS  
HAMMOND ROAD, KIRKBY INDUSTRIAL ESTATE, LIVERPOOL  
TELEPHONE, SIMONSWOOD, 2491 (3 LINES)

# The MULTI-CLAMP



*The All-Purpose Builder's Clamp with*

**DOUBLE RANGE**

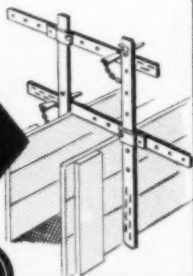
**THE DOUBLE RANGE** gives over 1000 square and rectangular adjustments from

4" to 2' 9" for clamping column and beam shuttering.

This range is wider than that of ANY TWO SETS of clamps at present available.

Write for  
Brochure M.C.1

**THE DOUBLE ACTION** with the "open-fork" construction, shown below, offers a further wide range of adjustments for clamping ground beams, walls, site piles, and T-beams.



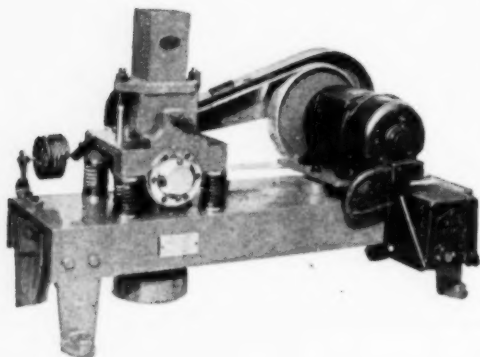
**DOUBLE ACTION**

**MABEY & JOHNSON LTD.**

54 VICTORIA STREET, LONDON, S.W.1.

VICTORIA 8026-8

## "CAPCO" H. F. VIBRATOR



for compacting mortar cubes for Compression Test B.S. 12/1947, B.S. 915/1947, B.S. 146/1947, B.S. 1370/1947. New type automatic control—optional. The vibrator illustrated in the B.S. was built in our works.

The "CAPCO" range of concrete testing apparatus also includes Cube Moulds; Slump Cones; Tensile, Vicat, and Cylindrical Moulds; Tile Abrasion Machines; Compacting Factor Apparatus.

Full details on request.

**CAPCO (SALES), LTD.**

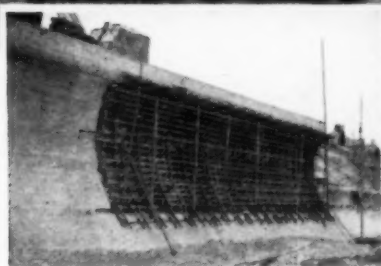
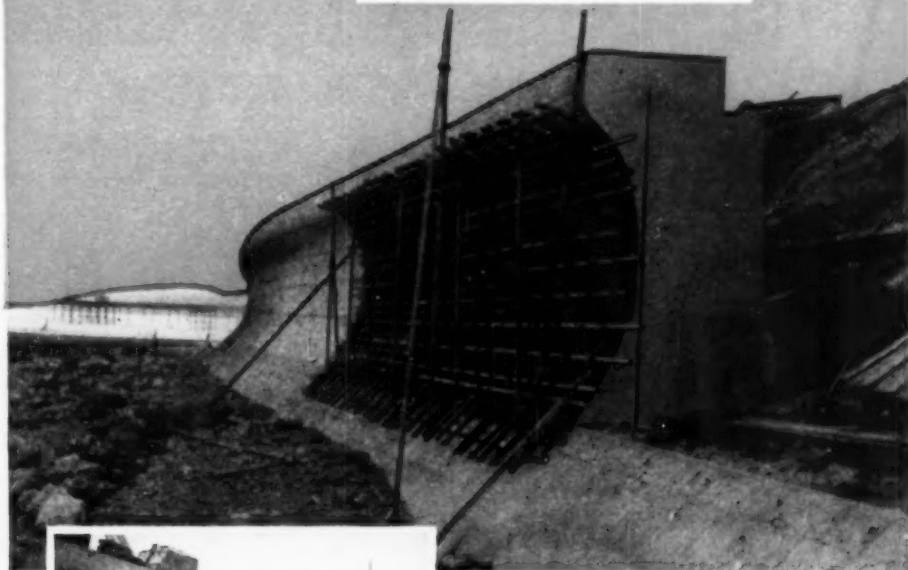
(Sole Agents for all "Capco" Products)

BEACONSFIELD ROAD, LONDON, N.W.10. Telephone: WILLEDEN 0067-8. Cables: CAPLINKO, LONDON

Colwyn Bay Sea Defence is sure

thanks to

**RAPID METAL**  
*Formwork*



- Authority : Borough of Colwyn Bay.
- Contract : Sea wall and other works between College Avenue and Foreshore Park.
- Engineer : N. S. Jeffrey, Esq., A.M.I.C.E., M.I.Mun.E., Borough Engineer and Surveyor.
- Main Contractors : Messrs. Roger Hughes & Company Ltd., Old Colwyn.

The curved shutter unit illustrated is formed entirely of Rapid Metal standard straight panels which, when this job is completed, become immediately available for any other type of steel shuttering work. Only one steel shuttering unit was used. As the work progressed the unit was moved to the next section without dismantling. Truly a striking example of how Rapid Metal Shuttering does a **better** job, easier, quicker, cheaper.

**You can depend on**

**RAPID METAL**  
*Formwork*

Sole Patentees and Manufacturers :

**RAPID METAL DEVELOPMENTS LTD.**, 209 Walsall Rd., Perry Barr, Birmingham, 22b. Tel : BIRchfields 8021

# GUNITE AND CEMENTATION



Systematic repairs to structures  
based on systematic diagnosis of  
defects.

## WHITLEY MORAN & CO. LTD.

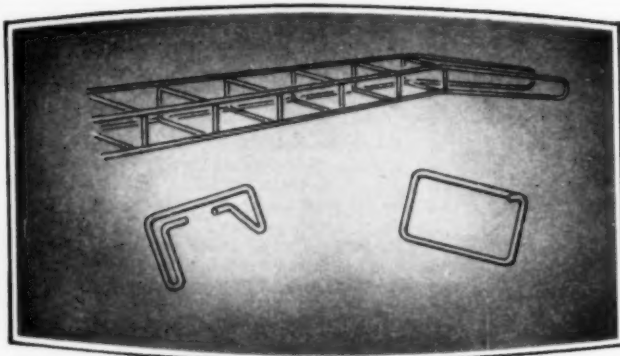
*Specialists in the Repair of Engineering Structures*

**GUNITE**

5 OLD HALL STREET, LIVERPOOL.

Telephone: Central 7975

## —CONCRETE— REINFORCEMENT



We carry large stocks of M.S. and High Tensile Steel, which can be supplied cut to lengths, hooked and bent in accordance with schedules, or in random stock lengths, from our Stock-holding Department.

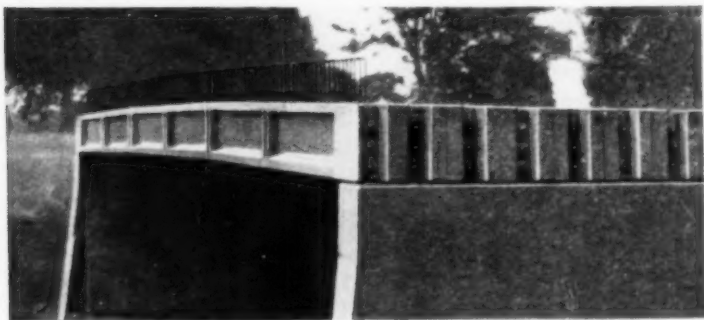
We specialise in Large projects, for which our Designers are always at your service.

FOR ALL CONSTRUCTION PURPOSES

## SOMMERFELDS LTD.

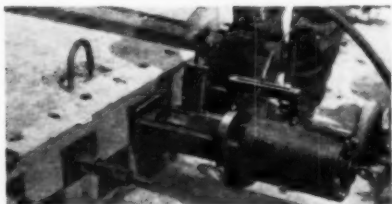
WELLINGTON • SHROPSHIRE • Tel.: Well. 1000

LONDON OFFICE: 167 VICTORIA ST. • TELEPHONE: VICTORIA 1000



1100-ft. Prestressed Concrete Culvert for the Lee Conservancy Catchment Board. Engineer: Marshall Nixon, M.B.E., T.D., B.Sc., A.M.I.C.E., A.M.I.Mech.E.

## WHICH WAY YOU LIKE . . .

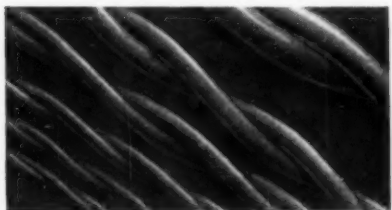


### "MACALLOY" BARS FOR USE WITH LEE-McCALL SYSTEM OF PRESTRESSED CONCRETE.

Working Stress of 95,000 p.s.i. An economical and effective system of prestressing concrete, using high-tensile alloy steel in bar form. The steel is provided with positive end-anchorage and does not rely upon bond to transmit the stresses to the concrete.

### "MATOBAR" WELDED FABRIC REINFORCEMENT.

To B.S. 1221-1945, Part A. Working Stress of 27,000 p.s.i. Economical for all types of concrete construction. Hard drawn, high-tensile steel wire mesh, electrically welded at every intersection.



### "ISTEG" STEEL REINFORCEMENT (MANUFACTURED UNDER LICENCE)

Twin Twisted Bars to B.S. 785-1938 and B.S. 1144-1943. Working Stress of 27,000 p.s.i. Steel bars with a combination of twist and cold working, giving 50% improvement in tensile stress; 30% less weight of steel. Improved bond. Hooks and overlenghts eliminated.

### INCREASED WORKING STRESSES.

The stress of 27,000 p.s.i. complies with C.P. 114, but in certain circumstances these stresses may be increased to 30,000 p.s.i. if due care is taken in the design, thereby showing still greater steel economy as recommended in the Ministry of Works Steel Economy Bulletin No. 1.

## REINFORCEMENT BY

# McCALLS

McCALL AND COMPANY (SHEFFIELD) LIMITED

TEMPLEBOROUGH · SHEFFIELD · AND AT LONDON

Tel.: Rotherham 2076 (5 lines)

Tel.: Sloane 0426

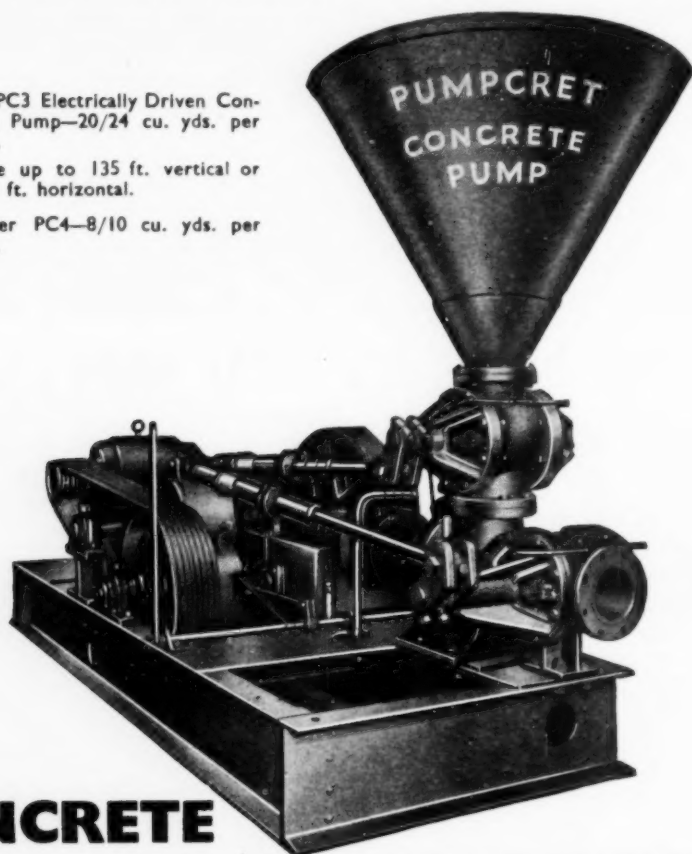
SRB, 47



The PC3 Electrically Driven Concrete Pump—20/24 cu. yds. per hour.

Range up to 135 ft. vertical or 1,500 ft. horizontal.

Smaller PC4—8/10 cu. yds. per hour.



## CONCRETE BY PUMP AND PIPELINE

- The latest and most efficient method of placing concrete.
- Life of Pump practically indefinite: all essential surfaces in contact with concrete are renewable.
- Pumpable concrete must of necessity be good concrete.
- Pump and Mixing Plant can be located at the most convenient position within the pumping range.
- The continuous output of the Pump at a constant speed governs the working of the whole concreting gang.

### THE CONCRETE PUMP COMPANY LTD

4 STAFFORD TERRACE, LONDON, W.8

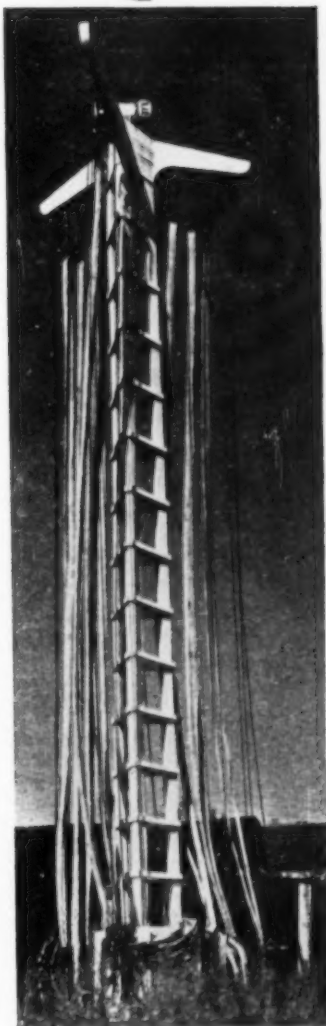
Telephone: Western 3546.

Telegrams: Pumpcret, Kens, London.



**Prestressed  
Concrete  
designed  
precast and  
erected by**

**A. & C.  
BUILDINGS LTD.**



We illustrate above a tower for drying fire hoses constructed in prestressed precast concrete for the Essex County Council's Fire Brigade Maintenance and Building Department, designed by us in collaboration with the County Architect.

**A. & C. BUILDINGS LTD. • CHURCH ROAD • THUNDERSLEY • ESSEX**

it  
stands  
alone

**FRAMEWELD**

TRADE MARK

Patent No. 589066

**PREFABRICATED WELDED REINFORCEMENT**

saves  
time  
labour  
money

**T. C. JONES & COMPANY LIMITED**

REINFORCEMENT SPECIALISTS

*1903—1953—50 Years of Service to Industry*

WOOD LANE, LONDON, W.12 • Telephone : Shepherd's Bush 2020.  
BUTE STREET, CARDIFF • Telephone : Cardiff 28786.  
TREORCHY, GLAMORGAN • Telephone : Pentre 2381.

THE  
**600**  
GROUP  
OF COMPANIES



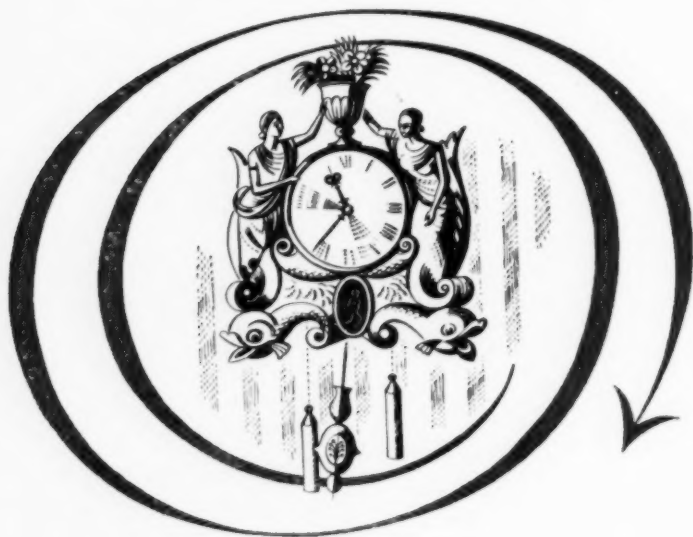
Set of 4 Permanent Hangars  
for the B.O.A.C. with Work-  
shops, Stores and Offices.  
London Airport. Carried out  
for the Air Ministry on  
behalf of the Ministry of  
Civil Aviation.

*Designers:* Sir Owen Williams  
and Partners.

**W. & C. FRENCH LTD.**  
Head Office: Buckhurst Hill,  
Essex. Tel.: Buckhurst 4444



## Twice round the clock...



*concrete sufficiently hard for almost any purpose*

On new and urgent work, use '417 Cement.' On repairs to services—roads, sewers, railways—that must be reinstated without delay, use '417 Cement.' Concrete made with this cement is ready for almost any duty in 24 hours—and for many in a good deal less. For example, in a temperature of 60°-65° F., concrete road foundations can be surfaced within 24 hours and opened to traffic immediately; concrete floors can be used for foot traffic in 12 to 16 hours. Concrete made with '417 Cement' is less liable to damage by frost. Please write for full details.

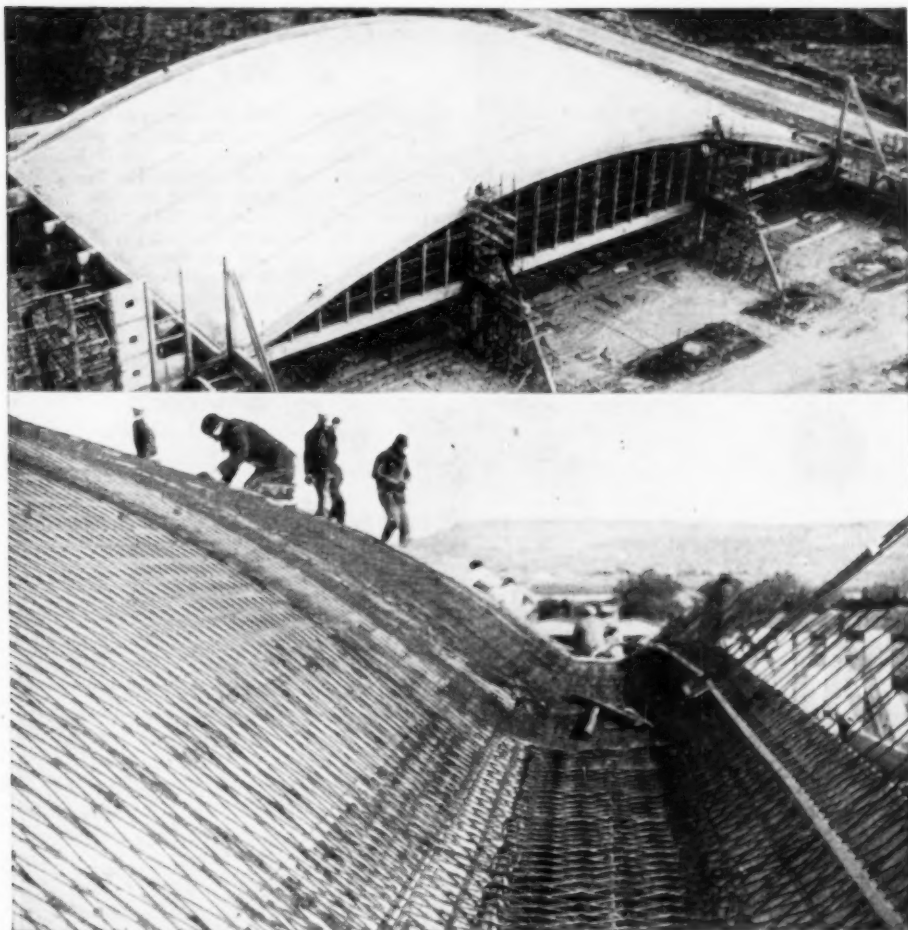
# '417 cement'

**QUICK SETTING — EXTRA RAPID HARDENING**

THE CEMENT MARKETING CO. LTD., Portland House, Tothill Street, London, S.W.1  
or G. & T. EARLE LTD., Cement Manufacturers, Hull

THE SOUTH WALES PORTLAND CEMENT & LIME CO. LTD., Penarth, Glam.

**BRITISH CEMENT IS THE CHEAPEST IN THE WORLD**



Expanded Metal Reinforcement was used for the 330 ft. span double hangar at the Marseilles-Marignane Airport, France. Ordinary round steel rods were originally specified but Expanded Metal was adopted finally for the following reasons: (1) Superior Bond . . . slipping impossible.

(2) Protection of Steel better assured because sheets could be placed more exactly at centre of concrete without risk of displacement during concreting. (3) Better distribution of steel for equal weight per sq. yard. (4) Simplification of the reinforcement.

*Designed and built by Des Entreprises Boussiron.*

*Photo: Ray-Delvert.*

# Expanded Metal

THE EXPANDED METAL COMPANY LTD., Burwood House, Caxton Street, London, S.W.1 ABBey 3933  
Stranton Works, West Hartlepool Hartlepool 2194

ALSO AT: ABERDEEN, BELFAST, BIRMINGHAM, CAMBRIDGE,  
CARDIFF, EXETER, GLASGOW, LEEDS, MANCHESTER



## EXPAMET PRODUCTS

Expamet Expanded Steel and Aluminium

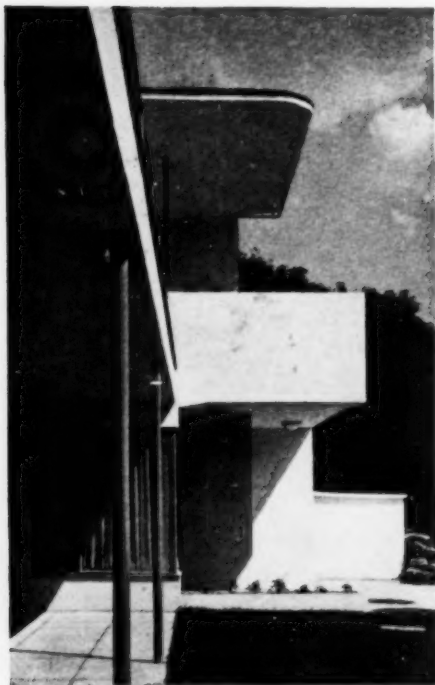
Flattened Expamet

BB Lathing

Exmet • Ribmet

Super-Ribmet

XPM Welded Fabric



## A better surface at less cost

Masonite Tempered Presdwood as a form-lining produces a smooth, flawless, and dense surface; concrete requires no further treatment after forms are removed. **Masonite Tempered Presdwood** is Grainless Wood specially impregnated for heavy duty; since 1930 it has been used successfully for shuttering on contracts of all kinds. Ten to fifteen uses are common. It is easy to work on site, does not corrode or leave unsightly marks or stains; it is flexible and ideal for shuttering to curved work.

Registered Trade Mark



## Tempered Presdwood

HAS BEEN USED AND PROVED  
FOR 20 YEARS

Write for illustrated Technical Catalogue.

**Masonite Ltd.**, Bevis Marks, London, E.C.3  
Avenue 2846

**CONCRETE  
PROOFING  
Co. LTD.**

**GUNITE  
SPECIALISTS**

Expert advice and schemes submitted for gunite work of every kind. Complete information on the various uses of gunite will be gladly sent on request.

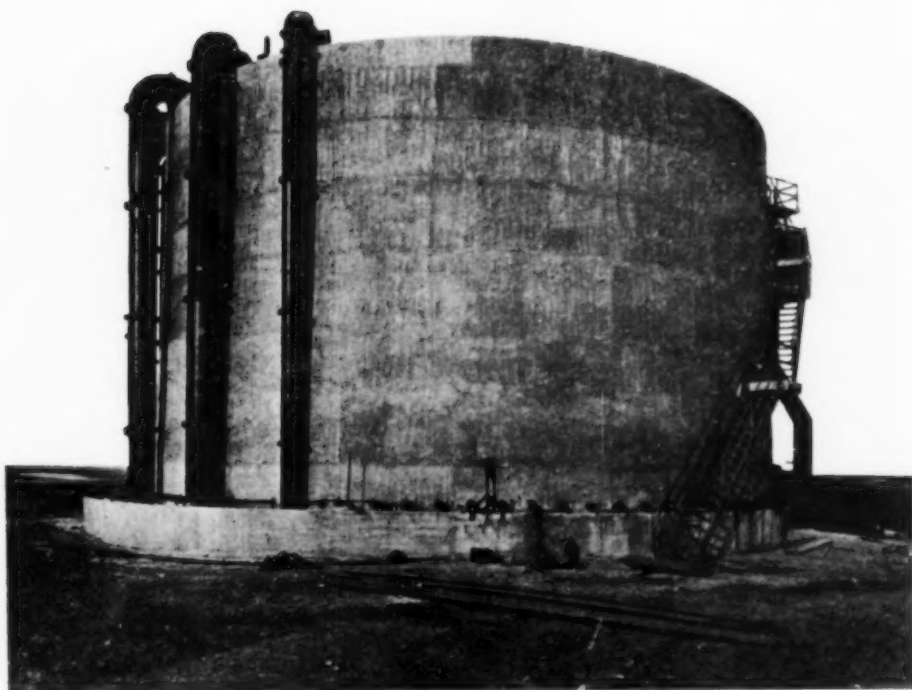
96, Victoria Street, Westminster, S.W.1

Telephone:  
VICTORIA 7877 and 8278

# HOLST

& CO LTD

CIVIL ENGINEERING CONTRACTORS, REINFORCED CONCRETE



## DESIGN AND CONSTRUCTION

Head Office:

NETHERFIELD, BERKHAMSTED, HERTS.

Telephone: Berkhamsted 1128-30

Branches: LONDON, BIRMINGHAM, MANCHESTER, LEEDS, EDINBURGH, CARDIFF



# RAWLTIES

**ENDORSED BY  
IMPORTANT  
CONCRETE USERS**

Today most Building Contractors and Civil Engineers know by experience that Rawlties, Rawloops and Rawlhangers make erection and striking far speedier, far easier and far more economical, with both steel and timber shuttering.

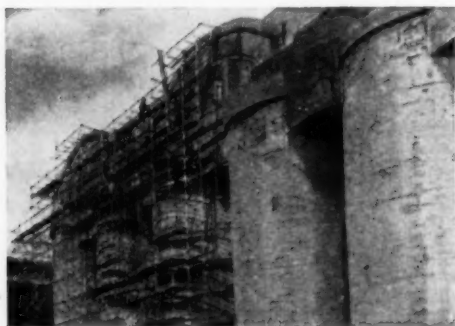
*Here are a few of the many satisfied users of Rawlties, Rawloops and Rawlhangers.*

E. B. BADGER & SONS (Great Britain) LTD  
RICHARD BAILLIE & SONS LTD • W. E. CHIVERS & SONS LTD • CUSTODIS (1922) LTD • J. L. EVE CONSTRUCTION CO LTD • F. C. CONSTRUCTION CO LTD • FOUNDATION (Plant) LTD  
GILBERT-ASH LTD • HOLLOWAY BROTHERS (London) LTD • WILSON LOVATT & SONS LTD • SIR ALFRED McALPINE & SON LTD • SIR ROBERT McALPINE & SONS LTD • MARPLES, RIDGWAY & PARTNERS LTD • MILLS SCAFFOLD CO LTD • F. G. MINTER LTD • TAYLOR WOODROW CONSTRUCTION LTD • TROLLOPE & COLLS LTD

*Write for Technical Publication No. R1401, which gives full details of this new way to speedier and more economical concrete construction.*

## RAWLTIES *for Concrete Savings*

THE RAWLPLUG COMPANY LTD • CROMWELL ROAD • LONDON • SW7



*Specialists in the Repair and Reconditioning of  
Defective Reinforced Concrete Structures, etc.*

THE

# GUNITE

CONSTRUCTION CO. LTD

WESTERN HOUSE, HITCHIN, HERTS.



## PRESTRESSED CONCRETE BEAMS

Three and a half miles of the 15-mile crossing between St. Petersburg and Palmetto being constructed in prestressed concrete are designed on the Lee-McCall System. The pile bents are at 48-foot centres and each span consists of six precast beams, each post-tensioned with three 1-in. diameter "Macalloy" high tensile steel bars tied with an in situ deck slab.

This project is under the direction of Mr. W. E. Dean, Chief Bridge Engineer to the State of Florida, and the Consulting Engineers are Parsons, Brinckerhoff, Hall and Macdonald, of New York. The prestressed beams are being manufactured at Port Tampa by Hardaway Contracting Company, who are also the main contractors.

Particulars are given in Bulletin No. 1, available on request.

**McCALLS MACALLOY LIMITED**  
 TEMPLEBOROUGH • SHEFFIELD • P. O. BOX 41  
 TELEPHONE: ROTHERHAM 2076 (P. B. EX 5 LINES) • LONDON OFFICE: 8-10 GROSVENOR GARDENS S.W.1

# EXPANSION



Flexpand is suitable for use with either concrete floors or roads. It consists of a solid cake of bitumen between two layers of bitumen felt. When inserted between the joints of the concrete it takes up the contraction and expansion due to temperature changes. In addition, Flexpand Expansion Jointing minimises the risk of crumbling edges caused by heavy wheel traffic.

**ANDERSON'S FLEXPAND**  
D. ANDERSON & SON LTD., STRETFORD, MANCHESTER

Roach Road, Old Ford, London, E.3

Expansion Jointing  
AND CONCRETING PAPER

## SEALOCRETE PRODUCTS...

*...make  
concrete what  
it should be*



STAND NO. B614  
B.I.F.  
BIRMINGHAM

WATERPROOF  
HARDENED  
DUSTPROOF  
OILPROOF  
COLOURED  
DECORATIVE

Waterproofing and Decorative Products for Brickwork, Asbestos-Cement & Allied building surfaces



Floor laid incorporating Sealocrete Coloured Cork Flooring Compound in Pavilion "Much Binding in the Marsh" at the Van Riebeeck Festival Fair, Cape Town, South Africa, 1952.

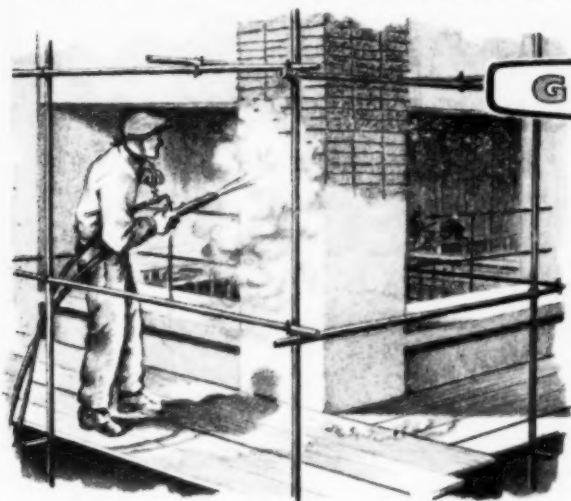


New Esso Refinery, Fawley. For Esso Petroleum Co. Ltd. Sealocrete Metallic Hardener used in concrete floors of the Central Maintenance Building.

Contractors: Messrs. Foster Wheeler, Ltd.

## SEALOCRETE PRODUCTS LTD

Atlantic Works, Hythe Road, London, N.W.10. Tel.: LADbroke 0015/6/7. Grams: "Exploiture Wesphone, London."

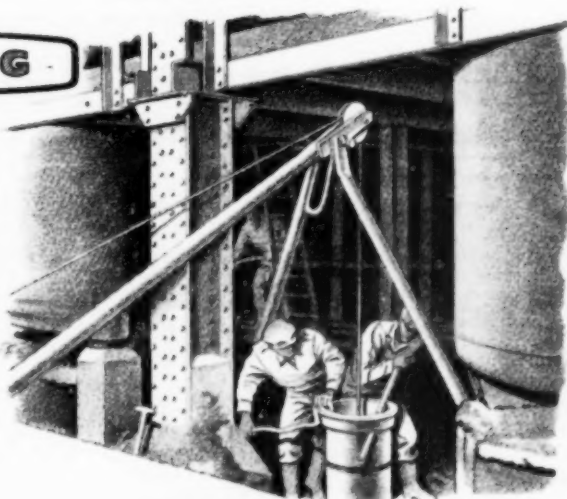


## GUNITING

The successful way to recondition defective concrete structures, encase structural steelwork, and line tunnels and water reservoirs. Developed and applied in all parts of the world with the resources, experience and skill of The Cementation Company, Ltd.

## PILING

The Cementation Company, Ltd. have the resources and the experience to undertake piling work for Hammer Foundations, Factory Extensions, Machinery Bases, Underpinning, Bridges and any similar purpose in any part of the world. And the skill to complete the work quickly and inexpensively even where headroom and working space are limited and freedom from harmful vibration is essential.



## CEMENTATION

For nearly half a century we have, by one or more of our processes, successfully prevented leakage of water through, under and around dams, from service and impounding reservoirs, filter beds, draw-off tunnels and other ancillary works. Our reputation is world-wide.

THE

# CEMENTATION

*Company Limited*

BENTLEY WORKS · DONCASTER · Tel. DON. 54177-8-9



A symbol of quality materials, experienced workmanship, expert supervision, and excellent service.

# for all forms of **PRECAST CONCRETE**

We specialise in the production of Precast Concrete structural members to standard or special designs, also products for the Electrical Industry, Sports Ground Contractors, and Fencing Contractors, and shall be pleased to submit quotations for your requirements.

## **H.B. CONCRETE CO. LTD.**

Head Office and Works : VICARAGE ROAD, EGHAM, SURREY. Telephone : Egham 3092.



**DELIVERED DIRECT TO ANY  
CONTRACT BY MOTOR LORRY.**

**Quotations on Application.**

Telephone : Paddington 2024 (3 lines).

## **WASHED BALLAST, SAND, SHINGLE & Crushed Aggregate for Reinforced Concrete.**

**WILLIAM BOYER & SONS, LTD.**

*Sand and Ballast Specialists,*  
**IRONGATE WHARF,  
PADDINGTON BASIN, W.  
MEMBERS OF B.S. & A.T.A.**



**FOR ROAD  
REINFORCEMENT**

## **"CONCRETE SERIES" BOOKS ON CONCRETE**

These well-known books deal with practically every aspect of the design and construction of reinforced concrete and precast concrete, the manufacture and chemistry of cement, and kindred subjects. For a complete catalogue giving prices in sterling and dollars, send a postcard to :

**CONCRETE PUBLICATIONS, Ltd.**  
14 Dartmouth St., London, S.W.1  
England

# EVODE SUPPLY

## Seven Blacks

### All true Asphaltic Bituminous Paints



General purpose coating for iron, concrete, brick-work, glass, etc. Well suited for brushing, dipping and spraying.

Heavily bodied bituminous paint for use under extreme conditions of corrosion, particularly suitable for corrugated iron sheeting. Is A.I.D. approved.



For use on iron and steel where exceptional anti-corrosive qualities are required.



For the insides of drinking containers of iron and concrete, and reservoirs. Quick drying and odourless when dry.

Thoroughly heatproof (dry heat up to 450° F.) for slow combustion plants, etc.

Hot water resisting. For the inside and outside of hot water tanks.



As 505I but suitable for dew moist surfaces.

As 505S but suitable for dew moist surfaces.

**PRICES FROM 4/9 per gallon according to quantity and grade**

**WRITE FOR LEAFLETS TO: EVODE LTD., GLOVER ST., STAFFORD**

Telephone : 1590/1/2.

Telegrams : Evode, Stafford.



# MOULD OILS & COMPOUNDS

for every process of  
concrete production

## CONCREAM

This non-staining, smooth and easy working white mould oil can be used with confidence on all classes of in situ and precast concrete work where the use of a white mould oil is recommended.

## VIBRAMOL

This non-staining and non-separating mould oil is made specially for use on steel shuttering and moulds where vibrators are used, and provides a good film which is not readily moved under vibration.

## SPRAYMOL

This grade of mould oil has been specially produced for use with a spray gun. It can be used with great economy on all types of shuttering and moulds, and will not separate under pressure.

## "P.S."

Experience has shown that the production of precast and in situ prestressed concrete needs a special mould compound, and in collaboration with leading prestressed specialists we have produced Grade "P.S." Mould Compound for this class of work.

## "8.A."

This Mould Compound has been specially produced to satisfy the requirements of those engaged in the production of spun concrete products.

**CONCREAM** Regd.  
**VIBRAMOL** Regd.  
**SPRAYMOL** Regd.  
**"P.S." & "8.A."**

### PRODUCTS OF THE ORIGINAL MAKERS OF CONCRETE MOULD OILS

We specialise in the production of mould oils and compounds for concrete work of every kind, from mass concrete work to high-class architectural stone work, and have an unrivalled experience which enables us to give expert advice on all mould oil problems. We have a grade for every purpose, and will be pleased to submit full details, samples, and prices on request.

**RICH<sup>d</sup> HUMBLE & SON, LTD., COLUMBA OIL WORKS, LEEDS, 3**

Telephone : 27155.

ESTABLISHED 1854.

Telegrams : "Columba, Leeds, 3."



# SHEET PILES



ANOTHER  
**ANGLIAN**  
PRESTRESSED PRODUCT

Project carried out for City of  
Cambridge Corporation.

Consulting Engineers—  
Great Ouse River Board.

Chief Engineer—  
W. E. Doran, Esq., O.B.E.,  
B.A.I., M.I.C.E.

Contractors—  
Messrs. W. & C. French, Ltd.

**PYLONS • PILES & SHEET PILES • ROAD  
& RAIL BRIDGES • ROOF & FLOOR BEAMS**

**ANGLIAN BUILDING PRODUCTS LTD • LENWADE 15 • NORWICH • Tel. : Gt. Witchingham 91**

---

# GUNITE SPECIALISTS

**W.M. MULCASTER  
& CO. (CONTRACTORS) LTD.**

We invite inquiries for Gunite Linings and Renderings  
for new or old structures of every kind in any part  
of the country.

**HASLINGTON**

**CREWE**

Telephone: Crewe 2265-6.

## COPPER STRIPS

for expansion joints

All Reinforced Concrete Engineers recognise the advantages of using copper strips for sealing joints in concrete work. Copper is ductile, will not crack under repeated bending, is non-corrosive and is unaffected by wet concrete. We specialise in the supply of perforated copper strips of all required lengths and widths for expansion joints, and shall be pleased to submit prices against detailed specification.



**ALEX J. CHEETHAM LTD.**

MORTON STREET • FAILSWORTH • MANCHESTER

Telephone: FAIlsworth 1115/6

DS14

*Don't "make do"  
— You can NOW have the BEST*

### TOUGHNESS

SISALKRAFT Reinforced Waterproof Building Paper, being of 6-ply construction and doubly reinforced by two crossed layers of Sisal fibres, will withstand the roughest handling. The fibres are totally enclosed by two layers of bitumen, which in turn are faced with tough Kraft paper. That is why SISALKRAFT'S resistance to bursting, tearing and cracking during handling represents the greatest economy in applied cost.

### DURABILITY

The widespread use of SISALKRAFT for curing concrete and as a concrete underlay in road construction by Municipal and County Authorities and leading Public Works Contractors is a worthy tribute to its quality and durability. A cheap and inefficient paper is a bad investment. SISALKRAFT endures under the worst conditions, offering the best possible protection because of its ingenious reinforcement and robust make-up.

### MANAGEABILITY

Although SISALKRAFT is tough it is easily handled, thus it can be quickly transported and applied, at the same time reducing the cost for laying. For curing concrete SISALKRAFT can be obtained in the form of blankets of varying sizes according to requirements. There is no better method of curing and, due to the added strength built into the blankets during fabrication, a sufficient number of uses can be obtained to ensure economy.

*Use the BEST — it is essential*

**SISALKRAFT**  
TRADE MARK

**NOW AVAILABLE FROM STOCK**

Sole Distributors for British Sisalkraft Ltd.

**J.H. SANKEY & SON, LTD.**

**ALDWYCH HOUSE, ALDWYCH, LONDON, W.C.2**  
'Grams: Brickwork, Estrand, London

'Phone: HOLborn 6949

**REINFORCED  
CONCRETE  
by**



Prestressed Bridge at Dorchester for Dorset C.C. J. J. Leeming, M.I.C.E., County Surveyor.

# **A. G. MANSELL & CO. LTD**

## **CIVIL ENGINEERING AND BUILDING CONTRACTORS**

BRIDGES - RIVER AND SEA DEFENCE WORKS - WATER TOWERS - BUNKERS  
SILOS - INDUSTRIAL BUILDINGS - ROADS - FOUNDATIONS - AND PILING.

70 VICTORIA STREET, LONDON, S.W.1. Telephone: TATE GALLERY 0088



### **THE "JOHN BULL" CONCRETE BREAKER**

NEW "B.A.L." TYPE.

#### **INCREASED :—**

PENETRATION, RELIABILITY, LIFE.

#### **REDUCED :—**

VIBRATION, NOISE AND WEAR.

**THESE ARE THE SALIENT FEATURES  
OF THE NEW CONCRETE BREAKER**

★ ★ ★

**REAVELL & CO., LTD.**  
**RANELAGH WORKS, IPSWICH.**

TELEGRAMS: "REAVELL, IPSWICH."

TELEPHONE: 2124

# CHRISTIANI & NIELSEN



Extensions to Sewage Works for Burnley Corporation. Borough Engineer & Surveyor :  
A. G. Richardson, Esq., A.M.Inst.C.E., M.I.Mun.E.

**CHRISTIANI & NIELSEN LTD., 54 VICTORIA ST., LONDON, S.W.1**

*Telephone : Victoria 6152-5*

ALSO OFFICES AT: Aarhus — Asuncion — Bahia  
Bangkok — Buenos Aires — Cape Town — Caracas  
Copenhagen — Durban — Guayaquil — Hamburg  
Helsingfors — Lima — Lourenco Marques — Mexico City  
Montevideo — New York — Oslo — Paris — Rangoon  
Rio de Janeiro — Sao Paulo — Stockholm — The Hague



# GLASCRETE for SHELL ROOFS

Shell roofs can be efficiently lighted by simply placing precast GLASCRETE panels on the shuttering and casting in monolithic with the roof, thus saving time and labour in trimming openings.

Panels are cast to the curve of the roof and anchor bars are left protruding from the frame for bonding to the roof slab.



Factory, London.

Architects: Messrs. Clifford Tee & Gale.

Telephone: CEN. 5866  
(5 lines)

**J. A. KING & Co. LTD.,**  
181, QUEEN VICTORIA ST., LONDON, E.C.4.



**PIN YOUR FAITH  
TO THE TESTED  
BRAND.**

THIS LABEL ON  
EVERY BARREL  
CARRIES WITH IT  
FORTY YEARS'  
EXPERIENCE OF  
MANUFACTURE.

**NONE OTHER IS  
"JUST AS GOOD"**

**THE LEEDS OIL & GREASE CO.**  
LEEDS, 10

Phone 22480

'Grams: "Grease."



---

# *use the* **A.B.** **SERVICE** for concrete work

---

---

## SHUTTER PANELS

All sizes and types

## ADJUSTABLE SHORES

for floor and beam support

## ADJUSTABLE CENTRE FORMS

for floor support

## SHUTTERLOCK WALING CLIPS

for bracing with scaffold tube and locking the panels together, eliminating nuts and bolts in shuttering. Tremendous saving in erecting and striking costs

## COLUMN CLAMPS : BEAM CLAMPS

## ROAD FORMS : TRENCH STRUTS

We also design and manufacture Steel Moulds for Floor Beams, Piles, Railway Sleepers and all other precast concrete products

*Let us solve your problems*

### **A. B. MOULD & CONSTRUCTION CO., LTD.**

92 WHITEHORSE ROAD

CROYDON

SURREY

Telephone : Thornton Heath 4947.

Telegrams : Abmould, Croydon.

WORKS: VULCAN WAY, NEW ADDINGTON, SURREY

---



# STONE COURT AGGREGATES ★



*General View of Plant at Rickmansworth.*

## ONE OF OUR MODERN CONCRETE AGGREGATES PLANTS

High-grade concrete aggregates graded to any specification, and the most punctual delivery service in England, can now be given to all Contractors, Builders, and Municipal Authorities carrying out concrete work and road construction in London and Suburbs and the Home Counties.

Washed all-in Ballast 2 in. down.

$\frac{3}{4}$  in. Washed & Crushed or Un-crushed Shingle.

$\frac{3}{8}$  in. Washed & Crushed or Un-crushed Shingle.

Washed Pit Sand.

Soft Sand.

$\frac{3}{16}$  in. Crushed Grit.

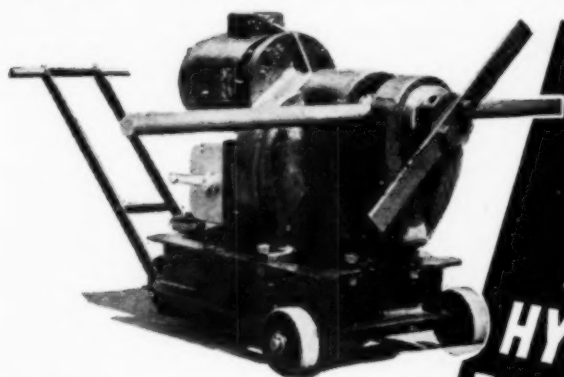


**STONE COURT BALLAST CO. LTD.**

PORTLAND HOUSE, TOTHILL ST., WESTMINSTER, S.W.1

Telephone : Abbey 3456.





*this is the*  
**ALLAM**  
*All-British*  
**HYDRAULIC  
 BAR CROPPER**

**CAPACITY**

ONE 1½ in. dia. MILD STEEL  
 or a Multiple of smaller bars

Details of this range, all types of concrete  
 vibrators, and contractors' plant, sent on request

**E · P · ALLAM & CO. LTD.**

LONDON: 45 Great Peter Street, S.W.1. Telephone: Abbey 6353 (5 lines)

SCOTLAND: 39 Cavendish St., Glasgow, C.5. Tel: South 0186. Works: Southend-on-Sea. Tel.: Eastwood 55243

**SUPER  
 CEMENT**  
**'SUBMARINE BRAND'**

THE TANNO-CATALYSED PORTLAND CEMENT

**SAVES TIME****SAVES TROUBLE**

NATURALLY WATERPROOF, CONTAINS NO WATER REPELLENT MATERIAL

**Uses:—****For CONCRETE**

Provides a CONCRETE of great strength  
 at early dates and impervious to water,  
 oil, etc., without any form of surface  
 coating.

**For PAVING**

Produces a hard wearing PAVING, dust-  
 less and proof against penetration by water,  
 etc.

**For RENDERING**

Supplies an impenetrable RENDERING of  
 such adhesive power that a 1" thickness will  
 resist an outside pressure of at least a 20'  
 head of water.

**For SLURRY (as paint)**

Makes a perfectly watertight covering to  
 brick or breeze concrete walls at very small  
 cost, and also provides the best watertight  
 undercoat to coloured finishes.

Technical Information is available to users.

Used in 1914-1918 and still used by:

Air Ministry, War Office, Admiralty, Ministry of Works, Ministry of Supply, etc.

**SUPER CEMENT LTD.,**

29 TAVISTOCK SQUARE, Phone:  
 LONDON, W.C.1 Euston 1808



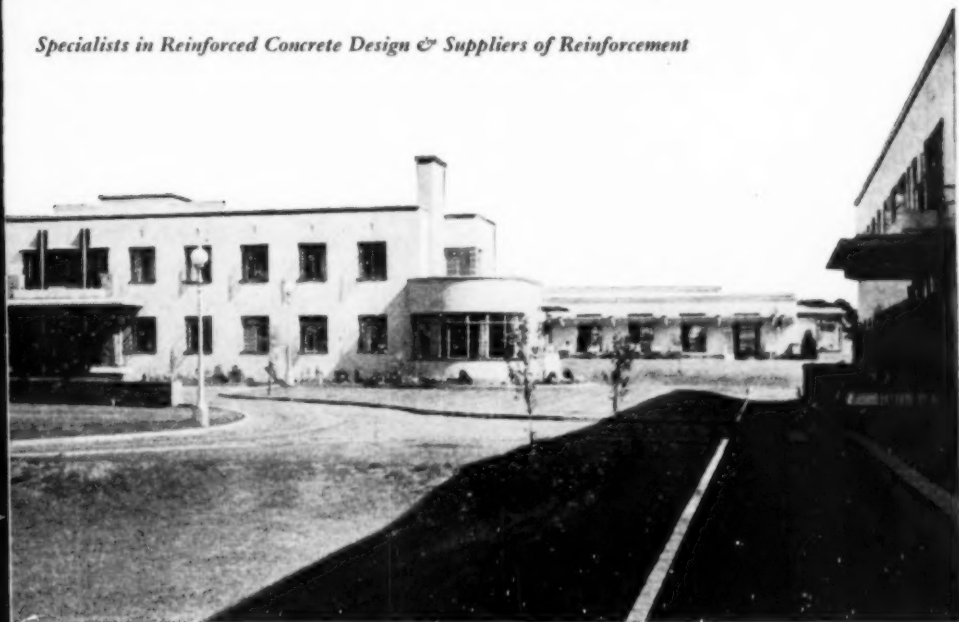
**THE BRITISH REINFORCED CONCRETE ENGINEERING CO. LTD., STAFFORD**

*For Hospitals:*

# Reinforced Concrete is construction at its best

## BRC

*Specialists in Reinforced Concrete Design & Suppliers of Reinforcement*



London, Birmingham, Bristol, Leeds, Leicester, Manchester, Newcastle, Cardiff, Glasgow, Dublin, Belfast



**ALPHA CEMENT LTD**

**PORTLAND HOUSE, TOTHILL STREET**

**LONDON, S.W.1.**

*Telephone - Abbey 3456.*

## CITY OF GLOUCESTER MAIN DRAINAGE SCHEME

CONCRETE  
SEGMENT  
TUNNEL

The illustration shows part of the 9 ft. diameter concrete segment tunnel now under construction for the City of Gloucester Main Drainage Scheme.

This tunnel, which forms the first section of the new scheme, will be lined with brickwork of 8 ft. internal diameter. Its completed length will be  $1\frac{1}{2}$  miles, of which a considerable portion passes through water-bearing strata.



Consulting Engineers: John Taylor & Sons, Westminster,  
with J. H. Goodridge, A.M.Inst.C.E., M.I.Mun.E., A.M.I.W.E.,  
City Engineer and Surveyor, Gloucester

**Contractors for:**

POWER STATIONS  
DOCK AND HARBOUR  
WORKS  
REINFORCED CONCRETE  
WORKS  
TUNNELLING IN FREE AND  
COMPRESSED AIR  
EARTHWORKS  
RAILWAYS  
MAIN DRAINAGE  
ROADS  
INDUSTRIAL BUILDINGS,  
ETC.

*Construction by*

**MARPLES,  
RIDGWAY & PARTNERS**

LIMITED

**CIVIL ENGINEERING CONTRACTORS**

**2 LYGON PLACE, GROSVENOR GARDENS, LONDON, S.W.1**

Telephone: Sloane 0781. Telegrams: Maripar, Sowest, London

**Cut costs; be more competitive:**

use:—

# ACROW

the world's largest selling

# PROP

WELL OVER 1,000,000 IN USE

—proof positive of their  
paramount superiority



★ Only Acrow Props  
have the Acrow (patent)  
Self-Cleaning Device

This consists of a downward extension of the nut over a segment of its circumference which forces away dirt lodged in the threads with an easy shearing action as the nut is turned. It enables props to be made ready for work instantly, no matter how encrusted the threads may be. 'Striking' on the site is easier, too, and involves none of the strain which might otherwise cause damage.

PROP SIZE No.	HEIGHT		WEIGHT
	Closed	Extended	
1	5 ft. 7 in.	9 ft. 10 in.	48 lb.
2	6 ft. 7 in.	10 ft. 10 in.	50 lb.
3	8 ft. 2½ in.	12 ft. 5½ in.	58 lb.
4	10 ft. 6 in.	15 ft. 6 in.	78 lb.

FOR SALE OR HIRE

Standard  
Type  
Prop

Beam  
Type  
Prop

**ACROW**—THE Specialists in Steel Shuttering & Propping

All enquiries to: **ACROW (ENGINEERS) LTD.**, South Wharf, London, W.2: Ambassador 3456 (20 lines)  
 22-24 City Road, Bristol, 2 (Bristol 24595) ● 130 Coventry Drive, Glasgow, E.1 (Bridgeton 1041)  
 Lupton Street, Hunslet, Leeds, 10 (Leeds 76514) ● West Stanley Street, Manchester, 5 (Trafford Pk. 2965)  
 Carl Street, Walsall, Staffs (Walsall 6296) ● 78 Duncrue Street, Belfast (Belfast 45211)

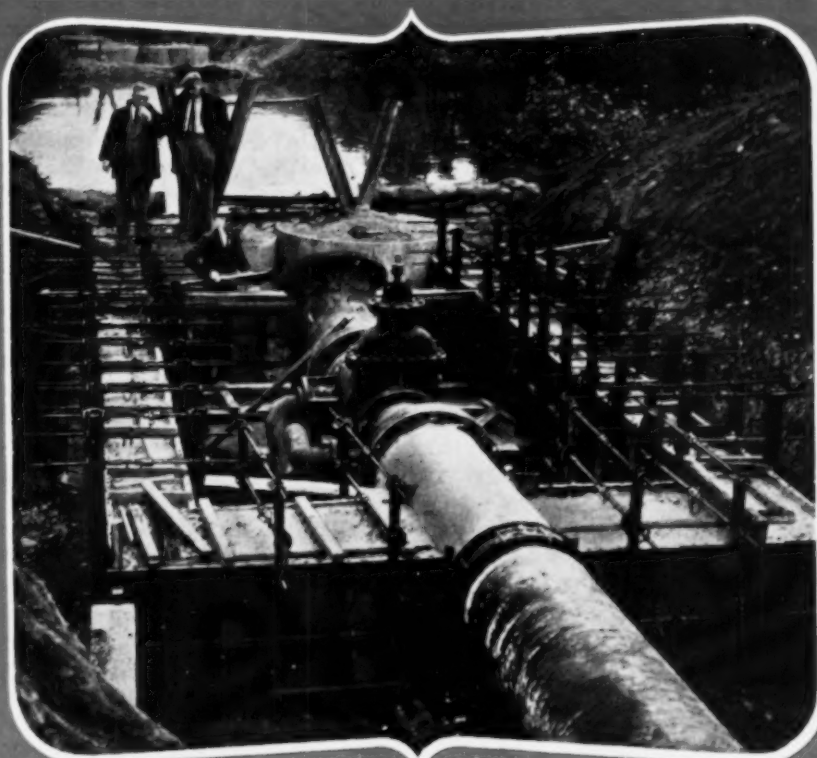


**SPEEDY ERECTION** and a **WATERTIGHT WALL** were two factors which led this contractor to shutter with

# ACROW { FERROFORMS and WALL-CLAMPS

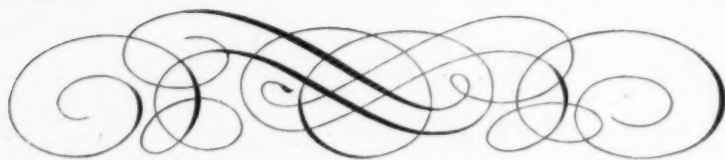
In the shuttering for these concrete bridge abutments, to carry a 27-in. diameter water pipe over the River Derwent, the general contractors, Messrs. Edward Thompson, Ltd., of Derby, had to meet two essential requirements:—maximum speed of shuttering erection and a watertight wall. Acrow Ferroforms, secured with Acrow Wall Clamps, met these needs in every respect. They are easily and quickly erected and involve no through bolts, tie-wires, or the like.

*The side walls were 18 inches thick, the end walls were 3 feet thick. The work was carried out to the instructions of I. G. Edwards, Esq., B.Sc., A.M.Inst.C.E., Engineer and Manager of the County Borough of Derby Water Dept.*

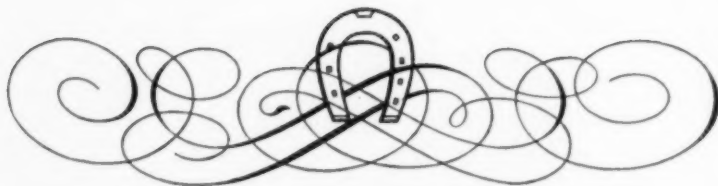


**ACROW Ferroforms & Wall-Clamps can be purchased or hired**

All enquiries to : ACROW (Engineers) Ltd., South Wharf, Paddington, London, W.2. Ambassador 3456 (20 lines)  
 22-24 City Road, **Bristol 2** (Bristol 24595) ● 130 Coventry Drive, **Glasgow**, E.1 (Bridgeton 1041)  
 Lupton St., Munslet, **Leeds**, 10 (Leeds 76514) ● West Stanley St., **Manchester**, 5 (Trafford Pk. 2965)  
 Carl Street, **Walsall**, Staffs (Walsall 6296) ● 78 Duncrue Street, **Belfast** (Belfast 45211)



*For*  
*Superior Concrete*  
*use*  
*Ketton Cement*



THE KETTON PORTLAND CEMENT CO LTD • ALBION WORKS SHEFFIELD

K/12

# CONCRETE AND CONSTRUCTIONAL ENGINEERING

INCLUDING PRESTRESSED CONCRETE

Volume XLVIII, No. 4.

LONDON, APRIL, 1953.

## EDITORIAL NOTES

### Shearing Stresses in Reinforced Concrete.

AN aspect of the design of reinforced concrete that is still the subject of debate concerns its resistance to shearing forces. This is not surprising in the case of a material which is so unlike the ideal elastic materials considered in the theory of elasticity and which, in a member designed to resist bending and subjected to its working load, has already cracked over a portion of its depth. For many years the subject was confused also by doubts whether failure was more likely to be caused by diagonal tensile stresses than by vertical or horizontal shearing stresses. An interesting historical study, recently published in the U.S.A.\*, of the various theories put forward since that by W. Ritter in the year 1899 shows how varied have been the views expressed.

The principles set out by Ritter for the design of web reinforcement are basically those in use to-day, but many years elapsed before his views were generally accepted; in fact many engineers of the day were of opinion that the action of vertical stirrups is similar to that of rivets in plate-girders and serve only to transfer horizontal shearing forces. The conception of stirrups acting as dowels was shown to be erroneous by Mörsch in the year 1906, but nevertheless it is still occasionally held to-day. In general the regulations at present in use in most countries are similar and the differences are largely on the question of whether or not the tensile strength of the concrete can be considered to contribute to the strength of the member beyond the limit at which reinforcement to resist shearing forces is required. The regulations and codes of practice in this country and in other European countries do not permit reinforcement to be designed to resist only the portion of the shearing force in excess of that resisted by the concrete, as do the regulations in the U.S.A. That authorities in different countries, using the same basis for assessing the maximum shearing stresses, using similar working stresses in the concrete and steel, and using about the same factors of safety, should require varying amounts of reinforcement shows the inadequacy of our knowledge of the magnitude and distribution of stresses due to shearing forces. It is particularly in the design of members which are deep in relation to their span, or on which the loads are adjacent to the supports, that improvements of the commonly-applied methods are desirable. Although the principal tensile stress is accepted as the critical stress, little account is generally taken of the effect of the vertical compressive stresses which occur near the supports

\* "What do we know about diagonal tension and web reinforcement in reinforced concrete?" E. Hognestad. University of Illinois Engineering Experiment Station. Circular Series No. 64.

when, as is usual, a load is applied to the top of a beam. With heavily-loaded short members these stresses are not negligible and, while their exact computation is not possible in the present state of knowledge, it should be possible for designers to make a judicious allowance for their effect; such an allowance would in all probability be no more inexact than other attempts to apply the theory of elasticity to reinforced concrete. Methods have, in fact, already been suggested by Continental engineers and deserve greater consideration in this country than they appear to have had.

The same considerations apply to the design of members in frames where high shearing forces are frequently accompanied by axial forces, an outstanding example being the Vierendeel girder. There has not, to our knowledge, yet been presented a generally-accepted method of calculating the stresses due to a combination of shearing forces and direct tensile or compressive forces, although it is obvious that in the first case the principal stresses will be much higher than the shearing stresses, and in the second case much less.

Although experienced engineers have little difficulty in designing reinforcement to resist shearing forces, others are apt to find the recommendations of text-books if not contradictory at least confusing. For example, the length of a beam over which a bar bent up at 45 deg. is assumed to be effective is given variously as the horizontal projection of three-quarters of the length of the sloping portion of the bar to nearly twice the effective depth of the beam.

Methods have been developed to assess the ultimate strength of beams where failure is due to bending, but where failure is primarily due to shearing forces the same degree of accuracy is not yet possible. The factors which affect the ultimate strength in shear have been shown to include the tensile strength of the concrete, the amount of longitudinal reinforcement, the amount and distribution of shear reinforcement, the ratio of the span to the effective depth of the member, and the ratio of the effective depth to the distance of the load from the support. Research on the ultimate strength of beams failing in shear appears generally to have been confined to beams in which failure by bending has been prevented by the use of large amounts of longitudinal reinforcement, or beams with thin webs, or small ratios of span to depth, or such a combination of these factors that the beams have not been representative of those commonly used in construction. Comparison of the expressions derived by various investigators for the ultimate strength in shear is very difficult because all the considerations in one series of tests frequently do not appear in another. This, to a large measure, is due to the number of factors involved, and there is likely to be much confusion of thought and wrong interpretation of the results if all these factors are not borne in mind when comparing published test results.

Obviously much experimental work remains to be done before a reliable method will be available of calculating the ultimate strength of reinforced concrete beams in shear, and particularly in members subjected simultaneously to forces producing bending, shearing, and direct stresses. This is important not only because of its application to "ultimate load" methods of design, which many engineers consider have not yet progressed sufficiently to take the place of the methods now commonly in use, but because reinforced concrete has so little in common with the ideal elastic material of theory, both methods derive their validity from tests and from the performance of actual structures.

## Continuous Beams on Wide Supports.

By ALBIN CHRONOWICZ.

THE analysis of continuous beams cast monolithically with wide supports is of special significance since the British Standard Code, CP.114, permits the width of the support to be taken into account in the calculation of the bending moments. The analysis can be based on column analogy if the conception of kern points is introduced. It is therefore necessary first to define these points and consider their positions in a short eccentrically-loaded column.

### Kern Points and Kern Distances.

If a point C (Fig. 1a) is at such a distance from the centroidal axis of a section of a short column that there is no stress  $f_b$  at the opposite edge of the section when a load  $P$  acts at C, the eccentricity  $e$  of the load is called a kern distance  $k_b$ , and

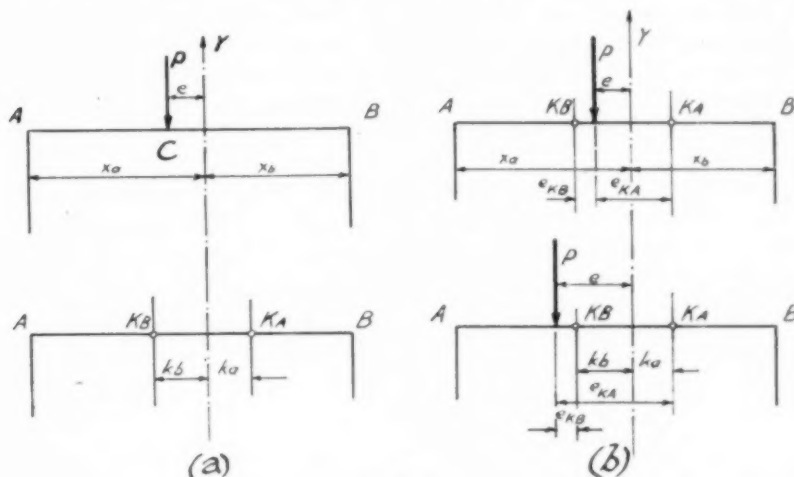


Fig. 1.

the point C is called one of the kern points  $K_B$  of the section. There is a similar kern distance  $k_a$  and kern point  $K_A$  on the other side of the centroidal axis.

If  $A$  is the cross-sectional area of the section,  $I$  the moment of inertia,  $\rho$  the radius of gyration, and  $x_a$  and  $x_b$  the distances from the centroidal axis to edges A and B respectively, the stress at B is given by

$$f_b = \frac{P}{A} - \frac{Pe}{I}x_b = \frac{Px_b}{\rho^2 A} \left[ \frac{\rho^2}{x_b} - e \right].$$

It is evident that  $f_b = 0$  when  $e = \frac{\rho^2}{x_b}$  and, from the definition,  $k_b = \frac{\rho^2}{x_b}$  and  $k_a = \frac{\rho^2}{x_a}$ . These kern distances are constant for a given section and do not depend on the nature of the loading.

## Stresses for any Loading.

If  $f_a$  and  $f_b$  are respectively the maximum and minimum stresses produced by a load acting at an eccentricity of  $e$  towards A,

$$f_a = \frac{Px_a}{\rho^2 A} \left( \frac{\rho^2}{x_a} + e \right) \text{ and } f_b = \frac{Px_b}{\rho^2 A} \left( \frac{\rho^2}{x_b} - e \right),$$

or 
$$f_a = \frac{P(k_a + e)}{I} x_a \text{ and } f_b = \frac{P[k_b - e]}{I} x_b.$$

Now  $k_a + e$  and  $k_b - e$  are the eccentricities of the load about the kern points  $K_A$  and  $K_B$  respectively. Denoting these eccentricities by  $e_{KA}$  and  $e_{KB}$  respectively (Fig. 1b), the products  $Pe_{KA}$  and  $Pe_{KB}$  are the moments  $M_{KA}$  and  $M_{KB}$  of the load about the kern points. Hence the stresses  $f_a$  and  $f_b$  can be expressed by

$$f_a = \frac{M_{KA} x_a}{I}; \quad f_b = \frac{M_{KB} x_b}{I}.$$

This property of the kern points leads to a straightforward determination of stiffness, carry-over factors, and fixed-end moments for use in the moment-distribution method of analysis of continuous non-prismatic beams. The application is useful in the case of beams cast monolithically with wide supports, and it leads to a fairly close approximation for beams with haunches.

## Beam Constants.

The stiffness  $S_A$  at A of a beam AB of uniform cross section and fixed at B (Fig. 2a) is the moment producing unit rotation of the beam at A. Therefore  $S_A$  is  $\frac{4EI}{l}$ , or  $4K$  if  $K$  denotes  $\frac{EI}{l}$ , the flexural rigidity of the beam. If the end B is freely supported (Fig. 2b),  $S_A$  is  $\frac{3EI}{l}$ , that is  $3K$ .

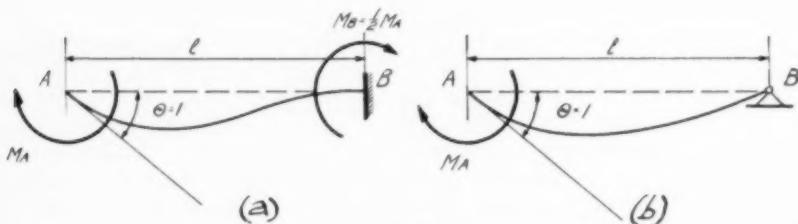


Fig. 2.

The stiffness of the beam at A can also be defined as the stress, at the corresponding edge A in the analogous column, caused by the unit load at A. For a beam fixed at both ends (Fig. 3a), the properties of the analogous column are:

$$\text{Area: } A = \frac{l}{EI}.$$

$$\text{Moment of inertia about the centroidal axis } y: I_y = \frac{l^3}{12EI}.$$

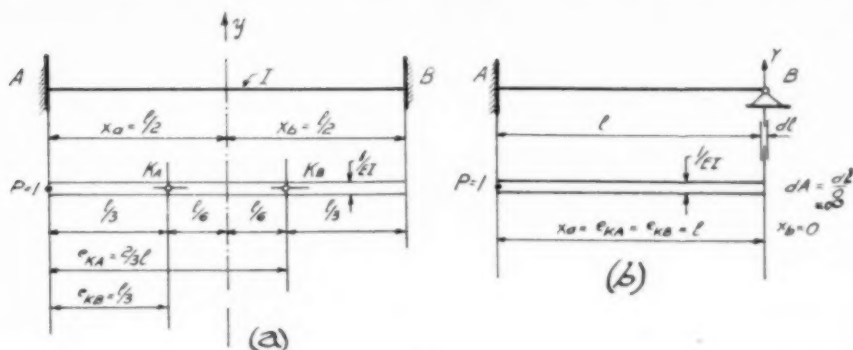


Fig. 3.

Centroidal distance:  $x_a = x_b = x = \frac{l}{2}$ .

Radius of gyration:  $\rho^2 = \frac{I_y}{A} = \frac{l^2}{12}$ .

Kern distance:  $k_a = k_b = k = \frac{\rho^2}{x} = \frac{l}{6}$ .

If unit load acts at A,  $e_{KA} = \frac{2}{3}l$ ,  $e_{KB} = \frac{l}{3}$ , and  $M_{KA} = 1 \times \frac{2}{3}l = \frac{2l}{3}$ . The stress at A is given by

$$f_{a(P=1)} = S_A = \frac{2l}{3} \times \frac{12EI}{l^3} \times \frac{l}{2} = \frac{4EI}{l} = 4K.$$

The carry-over factor  $r_a$  at A is the ratio of the stresses produced at B and A by unit load at A. Therefore

$$r_a = \frac{M_{KB} \times \frac{l}{2}}{I_y} \times \frac{I_y}{M_{KA} \times \frac{l}{2}} = \frac{M_{KB}}{M_{KA}} = \frac{e_{KB}}{e_{KA}} = \frac{l}{3} \times \frac{3}{2l} = \frac{1}{2}.$$

For a beam freely supported at B (Fig. 3b) there is an infinite elastic area at that point in the analogous column corresponding to rotational freedom. Both kern points are at B, so that  $e_{KA} = e_{KB} = l$ ,  $I_y = \frac{l^3}{3EI}$ ,  $x_a = l$ , and  $x_b = 0$ .

Hence:

$$S_A = f_{a(P=1)} = l \times \frac{3EI}{l^3} \times l = 3\frac{EI}{l} = 3K.$$

The stress  $f_b$  at B is  $l \times \frac{3EI}{l^3} \times 0 = 0$ ; therefore  $r_a = \frac{0}{3K} = 0$ .

### Beam Monolithic with Wide Supports.

For a beam cast monolithically with wide supports (Fig. 4), the moment of inertia over the width of the support is infinity, and the area of the analogous



column corresponding to this part of the beam is zero. Therefore, if the clear span of the beam is  $l'$ , the properties of the analogous column (Fig. 5) are :

$$A = \frac{l'}{EI}; \quad I_y = \frac{(l')^3}{12EI}; \quad x_a = al + \frac{l'}{2}; \quad x_b = bl + \frac{l'}{2}; \quad \rho^2 = \frac{(l')^3}{12EI} \cdot \frac{EI}{l'} = \frac{(l')^2}{12};$$

$$k_a = \frac{(l')^2}{12(al + l'/2)}; \quad \text{and} \quad k_b = \frac{(l')^2}{12(bl + l'/2)}.$$

Hence,

$$S_A = f_{a(p-1)} = e_{KA} \cdot \frac{12EI}{(l')^3} \cdot x_a.$$

Substituting,  $e_{KA} = \alpha l$ ,  $l' = \beta l$ , and  $x_a = \gamma l$ ,  $S_A = \frac{12\alpha\gamma}{\beta^3} K.$

The corresponding stress at B is

$$f_b = e_{KB} \cdot \frac{12EI}{(l')^3} \cdot x_b = \delta l \frac{12EI}{\beta^3 l^3} \gamma' l = \frac{12\delta\gamma'}{\beta^3} \times \frac{EI}{l} = \frac{12\delta\gamma'}{\beta^3} K,$$

if  $e_{KB} = \delta l$  and  $x_b = \gamma' l$ . Hence the carry-over factor at A is  $r_a = \frac{f_b}{f_a}$  and, by

substitution,  $r_a = \frac{\delta\gamma'}{\alpha\gamma}.$

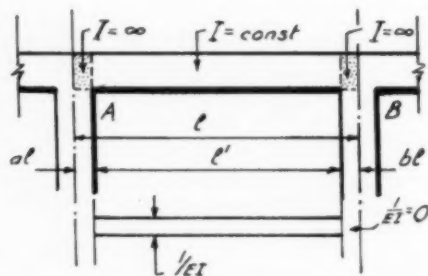


Fig. 4.

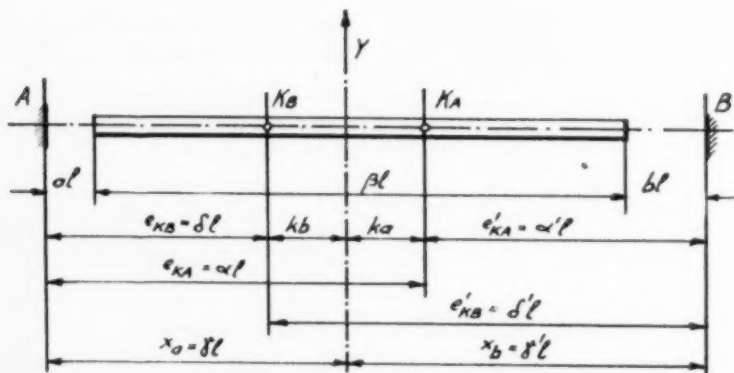


Fig. 5.

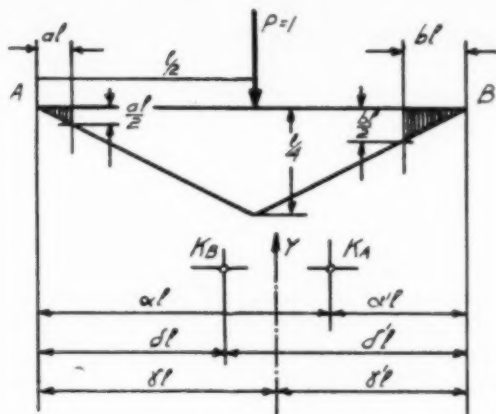


Fig. 6.

Similarly (referring to Fig. 5),  $S_B = f_{b(P=1)} = e'_{KB} \frac{12EI}{(l')^3} x_b = \frac{12\delta'\gamma'}{\beta^3} K$ ,

and if  $e'_{KB} = \delta'l$ ,  $r_b = \frac{\alpha'\gamma'}{\delta'\gamma'}$ .

These formulæ are now used to calculate the fixed-end bending moments due to unit load concentrated at midspan of a beam monolithic with wide supports (Fig. 6). The maximum bending moment on a free span is  $\frac{l}{4}$ , and the area of the free bending-moment diagram multiplied by  $\frac{1}{EI}$  is the analogous load. The moment of this load about the kern point  $K_A$  is

$$M_{KA} = \frac{l}{4} \cdot \frac{l}{2} \cdot \frac{1}{EI} \cdot (\alpha - 0.5)l - \frac{al}{2} \cdot \frac{1}{2} \cdot \frac{1}{EI} \left( \alpha - \frac{2a}{3} \right)l + \frac{bl}{2} \cdot \frac{1}{2} \cdot \frac{1}{EI} \left( \alpha' - \frac{2b}{3} \right)l$$

$$= \left[ 0.5(\alpha - 0.5) - a^2 \left( \alpha - \frac{2a}{3} \right) + b^2 \left( \alpha' - \frac{2b}{3} \right) \right] \frac{l^3}{4EI}$$

Hence the fixed-end bending moment at A is

$$M_A^F = \left[ 0.5(\alpha - 0.5) - a^2 \left( \alpha - \frac{2a}{3} \right) + b^2 \left( \alpha' - \frac{2b}{3} \right) \right] \frac{l^3}{4EI} \cdot \frac{12EI}{\beta^3 l^3} \cdot \gamma l$$

$$= \left[ 0.5(\alpha - 0.5) - a^2 \left( \alpha - \frac{2a}{3} \right) + b^2 \left( \alpha' - \frac{2b}{3} \right) \right] \frac{3\gamma l}{\beta^3} = ml$$

Ignoring the influence of infinite elastic areas at the intersection of a beam with wide supports, the fixed-end bending moment at A is  $M_A^F = 0.125l$ . Therefore the ratio  $\phi$  of the actual fixed-end bending moment to that based on the span between centres of the support is  $\frac{ml}{0.125l}$ , that is  $8m$ , and  $M_A^F = \phi M_l^F$ . The general value of  $\phi$  is given by

$$\left[ 0.5(\alpha - 0.5) - a^2 \left( \alpha - \frac{2a}{3} \right) + b^2 \left( \alpha' - \frac{2b}{3} \right) \right] \frac{24\gamma}{\beta^3}$$

Omitting expressions containing the third powers of  $a$  and  $b$ ,

$$\phi = (2\alpha - 1 - 4a^2\alpha + 4b^2\alpha') \frac{6\gamma}{\beta^3}.$$

Similarly  $M_B^F = \phi' M_l^F$ , and, omitting third powers of  $a$  and  $b$ ,

$$\phi' = (2\delta' - 1 - 4b^2\delta' + 4a^2\delta) \frac{6\gamma'}{\beta^3}.$$

The factors  $\phi$  and  $\phi'$  can be used for other types of loading if  $a$  and  $b$  are small, since the error resulting from such approximation is generally insignificant except in the case of concentrated loads acting near the supports.

EXAMPLE (Fig. 7).—The elastic modulus  $E$  is omitted from the calculation as it is constant. In this example  $a = 0.05$  and  $b = 0.10$ . Hence,

$$k_a = \frac{0.85^2}{12 \times 0.475} = 0.127, \text{ and } k_b = \frac{0.85^2}{12 \times 0.525} = 0.115.$$

Also,  $\alpha = 0.602$ ,  $\alpha' = 0.398$ ,  $\beta = 0.85$ ,  $\gamma = 0.475$ ,  $\gamma' = 0.525$ ,  $\delta = 0.360$ , and  $\delta' = 0.640$ . The stiffnesses are

$$S_A = \frac{12 \times 0.602 \times 0.475}{0.85^3} = 5.55K; \quad S_B = \frac{12 \times 0.64 \times 0.525}{0.85^3} = 6.55K.$$

The carry-over factors are  $r_a = \frac{0.36 \times 0.525}{0.602 \times 0.475} = 0.66$ ;  $r_b = \frac{0.398 \times 0.475}{0.64 \times 0.525} = 0.56$ .

Therefore

$$\phi = [(2 \times 0.602) - 1 - (4 \times 0.05^2 \times 0.602) + (4 \times 0.1^2 \times 0.398)] \frac{6 \times 0.475}{0.85^3} = 0.99.$$

$$\phi' = [(2 \times 0.64) - 1 - (4 \times 0.1^2 \times 0.64) + (4 \times 0.05^2 \times 0.36)] \frac{6 \times 0.525}{0.85^3} = 1.32.$$

The fixed-end bending moments (for unit load on unit span) and allowing for the width of the support are as in the tabulation alongside Fig. 7 (ii), the exact values of fixed-end moments being given in brackets. It is left to the designer to judge if these approximations are acceptable.

When more exact values are required, the following general rule can be applied (Fig. 8):

The area  $G$  of the free bending-moment diagram on the clear span  $\beta l$ , the position of the centroid  $C$ , and the respective eccentricities  $e_{KA}$  and  $e_{KB}$  about the kern points can be determined by semi-graphical approximate methods. The fixed-end bending moments are then

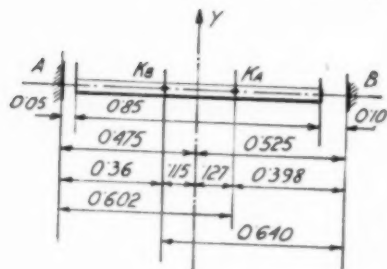
$$M_A^F = \frac{12Ge_{KA} \cdot \gamma l}{(\beta l)^3}; \quad M_B^F = \frac{12Ge_{KB} \cdot \gamma' l}{(\beta l)^3}.$$

#### Wide Support at One End only.

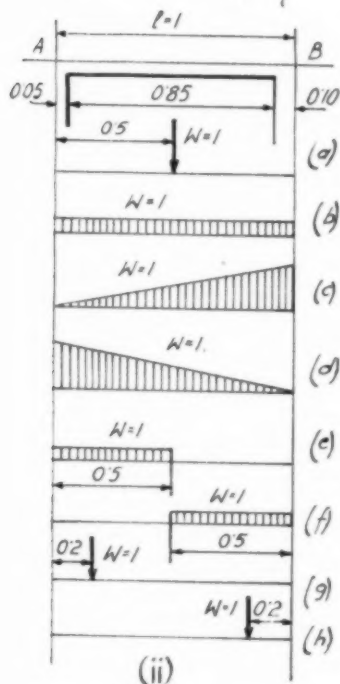
If a fixed-ended beam (Fig. 9) has a wide support at one end only, simplification of the beam constants results. As before,

$$A = \frac{\beta l}{I}; \quad I_y = \frac{\beta^3 l^3}{12I}; \quad \rho^2 = \frac{\beta^2 l^2}{12}; \quad k_a = \frac{\beta^3 l}{12\gamma}; \quad k_b = \frac{\beta^2 l}{12\gamma'};$$

$$S_A = \frac{12\alpha\gamma}{\beta^3} K; S_B = \frac{12\delta'\gamma'}{\beta^3} K; r_a = \frac{\delta\gamma'}{\alpha\gamma}; \text{ and } r_b = \frac{\alpha'\gamma'}{\delta'\gamma'}.$$



(i)



(ii)

Load a:  $M_A^F = 0.99 \times 0.125 = 0.124$  (0.122).

$M_B^F = 1.32 \times 0.125 = 0.165$  (0.167).

" b:  $M_A^F = 0.99 \times 0.083 = 0.082$  (0.082).

$M_B^F = 1.32 \times 0.083 = 0.110$  (0.109).

" c:  $M_A^F = 0.99 \times 0.067 = 0.066$  (0.080).

$M_B^F = 1.32 \times 0.10 = 0.132$  (0.110).

" d:  $M_A^F = 0.99 \times 0.10 = 0.099$  (0.109).

$M_B^F = 1.32 \times 0.067 = 0.088$  (0.082).

" e:  $M_A^F = 0.99 \times 0.115 = 0.114$  (0.127).

$M_B^F = 1.32 \times 0.051 = 0.067$  (0.064).

" f:  $M_A^F = 0.99 \times 0.051 = 0.050$  (0.036).

$M_B^F = 1.32 \times 0.115 = 0.152$  (0.155).

" g:  $M_A^F = 0.99 \times 0.128 = 0.127$  (0.149).

$M_B^F = 1.32 \times 0.032 = 0.042$  (0.029).

" h:  $M_A^F = 0.99 \times 0.032 = 0.032$  (0.013).

$M_B^F = 1.32 \times 0.128 = 0.169$  (0.173).

Fig. 7.

Similar simplifications occur in the expressions for the correcting factors  $\phi$  and  $\phi'$ . For a central unit load (Fig. 10):

$$M_{KA} = 0.25 \times 0.5(\alpha - 0.5) - \frac{a}{2} \cdot \frac{a}{2} \left( \alpha - \frac{2a}{3} \right) = 0.125(\alpha - 0.5) - \frac{a^2}{4} \left( \alpha - \frac{2a}{3} \right).$$

$$M_A^F = \left[ 0.125(\alpha - 0.5) - \frac{a^2}{4} \left( \alpha - \frac{2a}{3} \right) \right] \frac{12\gamma}{\beta^3}.$$

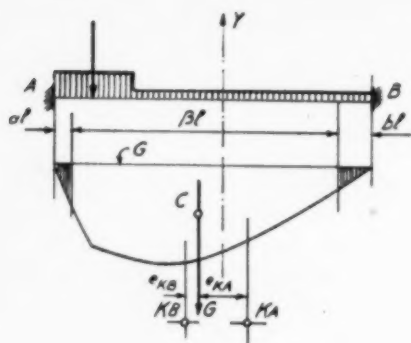


Fig. 8.

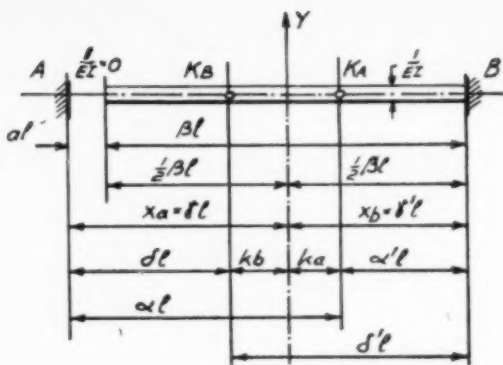


Fig. 9.

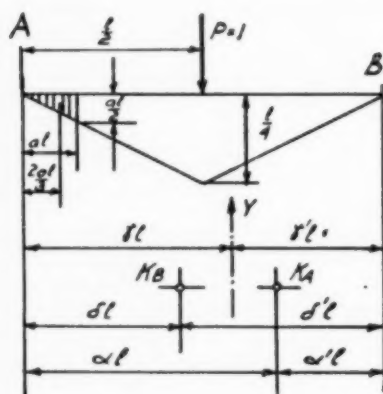


Fig. 10.

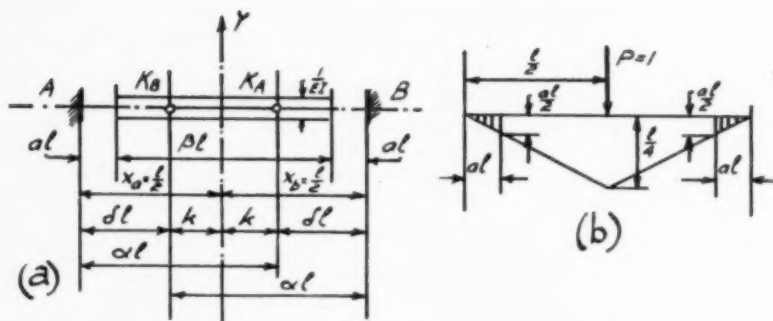


Fig. 11.

$$\phi = \left[ 0.5(\alpha - 0.5) - a^2 \left( \alpha - \frac{2a}{3} \right) \right] \frac{24\gamma}{\beta^3} \approx 6(2\alpha - 1 - 4a^2\alpha) \frac{\gamma}{\beta^3}.$$

$$M_{KB} = 0.125(0.5 - \delta) + \frac{a^2}{4} \left( \delta - \frac{2a}{3} \right).$$

$$M_B^F = \left[ 0.5(0.5 - \delta) + a^2 \left( \delta - \frac{2a}{3} \right) \right] \frac{3\gamma'}{\beta^3}.$$

$$\phi' = \left[ 0.5(0.5 - \delta) + a^2 \left( \delta - \frac{2a}{3} \right) \right] \frac{24\gamma'}{\beta^3} \approx (1 - 2\delta + 4a^2\delta) \frac{6\gamma'}{\beta^3}.$$

### Symmetrical Beams.

These expressions, when modified for symmetrical beams (*Fig. 11*), are very simple.

$$A = \frac{\beta l}{I}; \quad I_Y = \frac{\beta^3 l^3}{12I}; \quad \rho^2 = \frac{\beta^2 l^2}{12}; \quad k_a = k_b = k = \frac{\beta^2 l}{6}.$$

$$S_A = S_B = S = \frac{6\alpha}{\beta^3}; \quad r_a = r_b = r = \frac{\delta}{\alpha}.$$

$$M_A^F = M_B^F = M^F = \frac{G}{A} = \left[ (0.25 \times 0.5) - 2 \frac{a}{2} \cdot \frac{a}{2} \right] \frac{1}{\beta} = [0.25 - a^2] \frac{1}{2\beta} \text{ (Fig. 11b).}$$

$$\phi = (0.25 - a^2) \frac{8}{2\beta} = \frac{(1 - 4a^2)}{\beta}, \text{ and since } \beta = 1 - 2a, \phi = 1 + 2a.$$

EXAMPLE (*Fig. 12*).—For unit load on unit span the fixed-end bending moments calculated from the foregoing formulæ (the exact values being given in brackets) are:

$$\text{Load } a: M^F = 0.083 \times 1.2 = 0.0995 \text{ (0.0983).}$$

$$,, \quad b: M_A^F = 0.067 \times 1.2 = 0.079 \text{ (0.0767).}$$

$$M_B^F = 0.1 \times 1.2 = 0.12 \text{ (0.1307).}$$

The approximation  $\phi = 1 + 2a$  cannot be used in exact calculations for concentrated loads near the supports, and it is advisable to determine the values of fixed-end bending moments by the method described for unsymmetrical beams.

### One End of Beam Freely Supported.

If the beam is freely supported at one support (*Fig. 13*), the beam constants are  $I_Y = \frac{\beta^3 l^3}{3I}$ , and  $S_A = l \frac{3I}{\beta^3 l^3} = \frac{3}{\beta^3} K$ . Therefore

$$M_K = \left[ \left( \frac{1}{8} \times \frac{1}{2} \right) - \frac{a^2}{4} \left( 1 - \frac{2a}{3} \right) \right] \frac{l^3}{I} = [3 - 4a^2(3 - 2a)] \frac{l^3}{48I}.$$

$$M^F = \frac{1}{48} [3 - 4a^2(3 - 2a)] \frac{l^3}{I} \cdot \frac{3I}{\beta^3 l^3} \cdot l = [3 - 4a^2(3 - 2a)] \frac{l}{16\beta^3}.$$

$$\phi = \frac{1}{16} [3 - 4a^2(3 - 2a)] \frac{l}{\beta^3} \cdot \frac{16}{3l} = \frac{3 - 4a^2(3 - 2a)}{3\beta^3} \approx \frac{1 - 4a^2}{\beta^3}.$$



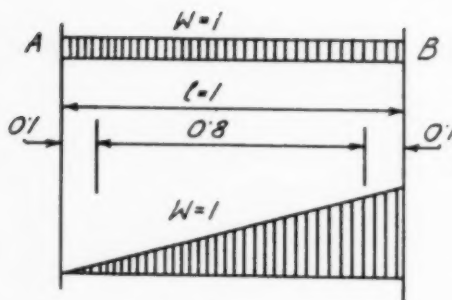


Fig. 12.

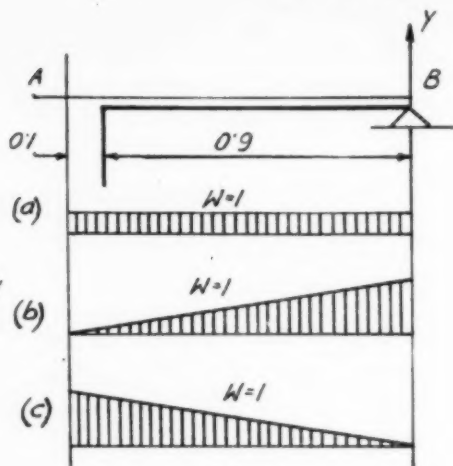


Fig. 14.

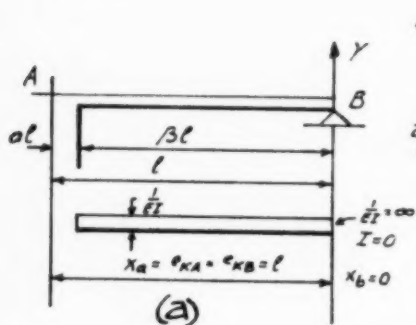
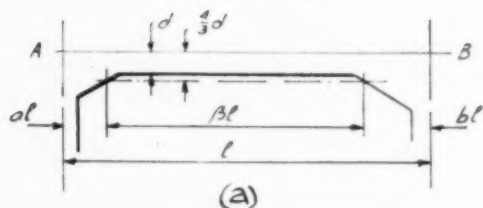
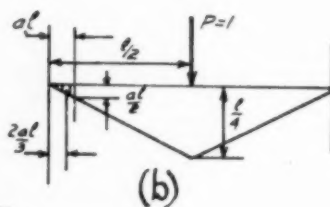


Fig. 13.



(b)

Fig. 15.

EXAMPLE (*Fig. 14*).—As before, there is unit load on unit span, and exact values of the fixed-end bending moment are given in brackets.

$$a = 0.1; S = \frac{3}{0.9^3} K = 4.1K; \phi = \frac{1 - 0.04}{0.9^3} = 1.32.$$

$$\text{Load } a: M^F = 0.125 \times 1.32 = 0.165 \text{ (0.162).}$$

$$,, \quad b: M^F = 0.116 \times 1.32 = 0.153 \text{ (0.152).}$$

$$,, \quad c: M^F = 0.133 \times 1.32 = 0.175 \text{ (0.172).}$$

### Haunched Beams.

The method described can be readily applied to the approximate analysis of haunched beams. The "clear span", corresponding to the span between the faces of the supports, is assumed to be the distance between the points at which the depth of the haunch is  $1\frac{1}{3}$  times the depth of the beam (*Fig. 15a*). The approximate results are given in the following example of a symmetrical beam with straight haunches (*Fig. 15b*). The approximate constants are:

$$k = \frac{0.8^2}{6} = 0.11; \alpha = 0.61; \delta = 0.39; S = 0.61 \frac{6}{0.8^3} = 7.2 \text{ (7.42);}$$

$$r = \frac{0.39}{0.61} = 0.64 \text{ (0.641); and } \phi = 1.2.$$

The exact values are given in brackets. The exact value of  $\phi$  is 1.21 for a concentrated load at midspan and 1.18 for a uniformly-distributed load.

## Fire Grading of Buildings.

THE principles of the design of buildings to reduce the risk of fire and to provide protection against fire were considered in "Fire Grading of Buildings, Part I," Post-war Building Study No. 20, published in 1946. A further three parts have now been published dealing with additional precautions considered necessary to ensure the safety of the occupants of a building. These are "Fire Grading of Buildings, Parts II, III and IV," Post-war Building Study No. 29 (H.M.S.O. Price 4s. 6d.), and are concerned with planning rather than the fire-resistance of building materials.

Part II deals with fire-detection and fire-fighting equipment and includes information on the space requirements for escape ladders up to 100 ft. high. Methods and data for assessing the safe density of population of buildings used for various purposes and recommendations on the numbers and positions of exits are given

in Part III, together with notes on structural precautions to reduce the spread of smoke, flames, and fire. Tables give recommendations on the number of persons to be permitted to use staircases of stated widths and from two to ten stories high for various densities of occupation. The construction of chimneys, flues, and hearths, and common defects in chimneys and flues in existing buildings, are considered in Part IV. Methods are described of insulating existing chimneys to reduce the risk of fire.

Appendixes include data on the rate of movement of people through exits, widths of staircases to serve stated numbers of persons, the supposed causes of fires, and the proposed minimum requirements for graded types of construction (reprinted from Part I).

Information relating to reinforced concrete construction was given in Part I and reviewed in this journal for June, 1947.

# The Ultimate Strength of Prestressed Beams.

From Professor A. L. L. Baker.

THE article by Professor G. Magnel on "The Ultimate Strength of Prestressed Beams" in this journal for February last contains some valuable results of tests of prestressed beams and an interesting proposal for simplifying the calculation of the ultimate strength in bending of prestressed beams.

Many engineers would, however, probably like to know what was the value of the prestressing in each beam at the time of the tests, whether or not the cables were bonded, and the precise definition of failure in the "under-reinforced" beams. Is not the linear relationship shown to exist between  $K$  and  $\lambda$  due to failure being initiated by non-recoverable strain causing a rise of the neutral axis? Also, do not the higher values of  $K$ , say, 0.25 to 0.33, depend not only on the area of steel but also on the prestress and on the efficiency of the bond? Fig. 1 shows three possible distributions of strain for the same area of steel: (1) A bonded beam in which the strain in the steel due to the load at failure minus the strain due to pre-tensioning is 0.0024; (2) An end-anchored beam in which this difference in strain is

0.0024; and (3) A bonded beam in which this difference in strain is 0.0072.

The position of the neutral axis is at about half the depth of the beam in the case of (1) and at about a quarter the depth in cases (2) and (3), so that the ultimate moment of resistance of the concrete for (1) is much greater than for (2) or (3). While the formula  $M = 0.318bd^2c_{up}$  may be correct when  $100\lambda = 0.84$  and the prestressing force and the bond are adequate, it is not strictly a general formula, which should include terms expressing the influence on the ultimate strength of the prestress and of the bond. Unless the special conditions for which the formula is valid are precisely stated, there is a danger that, well known though the conditions may be to specialists in prestressed concrete, the importance of bond and the correct prestress may not be appreciated by others.

Contractors will usually take care of structural requirements which are self-evident, but it is not at all obvious that a reduced prestress or lack of bond strength may be as serious as the omission of steel or cement. It is interesting to note that in your February number you reported that one cause of cracking under full working load of the footbridge at the

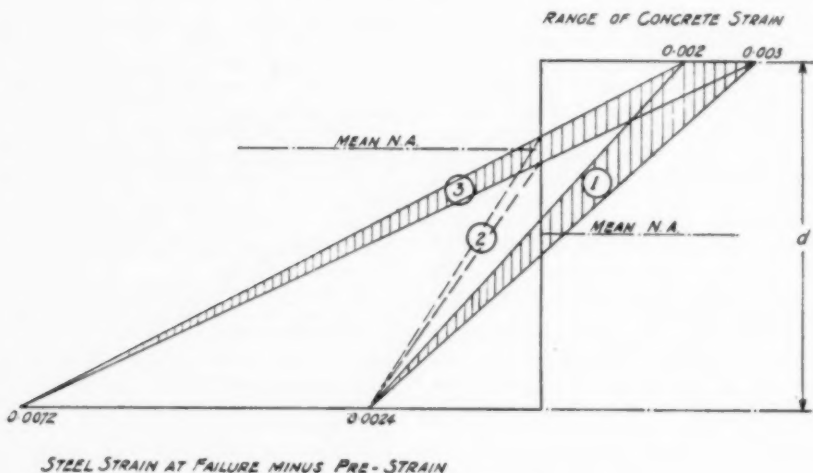


Fig. 1.—Distribution of Strain.

Festival of Britain site on the South Bank, London, was ineffective grouting.

**From Mr. Donovan H. Lee,  
B.Sc. (Eng.), M.I.C.E.**

I have little doubt all will agree that Professor Magnel has made an excellent contribution to this subject in your February number. I do not quite understand, however, why he appears to criticise some of the formulae at present in use for calculating the ultimate strength. Professor Magnel will no doubt agree that the ultimate strength of prestressed beams has for some time been calculable by these formulae as accurately as it is possible to calculate the ultimate strength of beams of most other structural materials.

Formula (1),  $M_t = 0.95 A f_t d$ , given by Professor Magnel, is limited to a restricted range of conditions, but even so it appears to give an ultimate strength slightly greater than, for example, the formula given by Dr. Abeles,  $M_t = K A f_u a d$ , since  $a$  varies between about 0.75 and 0.93 (say, 0.9 in the range named by Professor Magnel) and  $K$  is usually below 1.0 except when using pretensioned wires.

In other words, formula (1) if within about 10 per cent. of the ultimate strength would, I think, generally give values on the upper limit of this margin. Although in a test of one of the beams of the Tampa Bay bridge in which high-tensile bars were used the value  $K$  in Dr. Abeles' formula is greater than 1.0, in this case  $a$  has a value of about 0.95 and so fits in well with Professor Magnel's formula. The test was made with the deck slab acting in conjunction with the beam and therefore the value of 0.95 was practically ensured. The test would, perhaps, at least confirm that the bond was adequate to develop the full strength. The anchorage between the slab and the top of the beam was, as usual, excellent.

Whether or not formula (1) gives the average ultimate strength within 10 per cent. as suggested by Professor Magnel for the conditions named by him, or whether that formula gives values close to the upper limit, it would seem that the other formula I have mentioned for the ultimate strength will be more accurate unless  $K$  and  $a$  are both near to 1.0.

Undoubtedly Professor Magnel is correct in pointing out that some variations must be expected between the ultimate

strength as calculated and that obtained by test. Variation in the stress-strain curve for the wires between the 0.2 per cent. proof stress and the ultimate strength is, I think, of more importance than has been realised.

Bond has also been frequently pointed out as affecting the results, greasy or very smooth wires giving, of course, lower strengths. With bars the increased bond stress is counterbalanced by the very small quantity of grout needed, which reduces the loss of bond due to shrinking of the grout away from the surface of the concrete in the cavity. If the same care is taken in grouting bars and wires then either formula applies equally well whether the beam contains bars or wires, although for loads greater than the load causing cracking the deflections should be less in beams with bars.

Partially-prestressed beams (although the load causing cracks in them is lower and the deflection greater) have virtually the same ultimate strength as fully-prestressed beams. Also reinforced concrete, particularly when using cold worked high-tensile bars with deformed surfaces, has the same ultimate strength although with larger deflections.

It would appear, therefore, that Professor Magnel's formula (1) could easily be given wider application by variation of the coefficient of 0.95, but this would seem to bring the formula into line with other formulae already available except for the question of whether 0.95 in Professor Magnel's formula (1) is not higher than the mean value for normal fully-bonded construction. I would, therefore, be interested to know whether Professor Magnel considers that the examples on which his formula (1) is based represent the most favourable cases of effectiveness of bond or average cases. Alternatively if formula (1) is correct for the average case of post-stressed beams with well grouted wires, Dr. Abeles' formula must be pessimistic if a value of  $K$  below 1.0 is used for normal grouted conditions.

**From Professor G. Magnel.**

With regard to the comments by Professor Baker, I considered only anchored cables or cables in which wires with increased bond are used so that no slipping of the wires occurs before failure of the beam at midspan due to the ultimate

strength of either the concrete or the steel being exceeded. In my opinion the amount of the initial prestress is of no importance whatever in connection with the ultimate resistance of a beam with wires that do not slip. This is because the strain in the steel due to prestressing is negligible in comparison with the strain at failure. The results of the tests on the beam reinforced with Neptune steel confirm this (see pages 76 and 77 of this journal for February last).

So little is known of the strain of concrete at failure that I do not wish to make any comment on Professor Baker's statements regarding the strain diagrams. Some writers say that the strain at failure is constant, but the values given vary by 100 per cent. according to the writer.

The only way to show that my proposed formula is unsatisfactory is to compare it with further tests in which the results deviate by more than ten per cent. from my straight-line diagram of  $K_1$  as a function of  $\lambda$ . In this it is necessary to take into account the range of applicability of the formula [see items (a) to (h) on pp. 74 and 75 of my article].

I wish to stress the fact that my intention was not to discuss the problem in relation to small factory-made beams with pre-tensioned wires, as my interest in

prestressed concrete has always been in larger engineering works.

Regarding the comments of Mr. Donovan Lee, I did not in my article criticize any other formulae but only the way in which some writers produce these formulae from what I consider to be questionable theories, in which too many assumptions are made regarding the stress-strain diagrams of steel and concrete. My formula is based on the results of tests on beams stressed by post-tensioned and anchored cables, except in one case where I considered a beam which is not prestressed but reinforced with high-tensile steel with a greatly increased bond strength. I have never attempted to compare my formulae with the results of tests on beams prestressed by bonded wires without anchors. This case is more complicated if only because the wires are generally distributed over a greater area of the cross section of the beam.

My formula applies equally well to beams in which failure occurs first in the steel as it does to beams in which the concrete fails first. The formula which interests me most is formula (2), which is applicable even in cases where the area of steel is exceptionally great and where the crushing strength of the concrete has no practical importance even when the beam fails by crushing of the top flange.

### Proposed Terminal Building at Renfrew Airport.

THE proposed Terminal Building at Renfrew, the airport for Glasgow, is shown in Fig. 1. The main beams in the roof of the concourse are supported at the front of the building by hangers from a reinforced concrete arch 48 ft. high. The buildings have been designed to permit extensions to be made to them.

The architect is Mr. W. H. Kinin-

month, A.R.S.A., F.R.I.B.A., of Messrs. Rowand Anderson, Kininmonth & Paul, and the consulting civil engineers are Messrs. Blyth & Blyth. The contract has been let by the Ministry of Civil Aviation to Messrs. A. A. Stuart & Sons (Glasgow), Ltd., and work on the site has started. It is intended that the new building shall be completed by the summer of 1954.



Fig. 1.

## Foundation for a Large Hammer.

PRESTRESSED GROUTED CONCRETE.

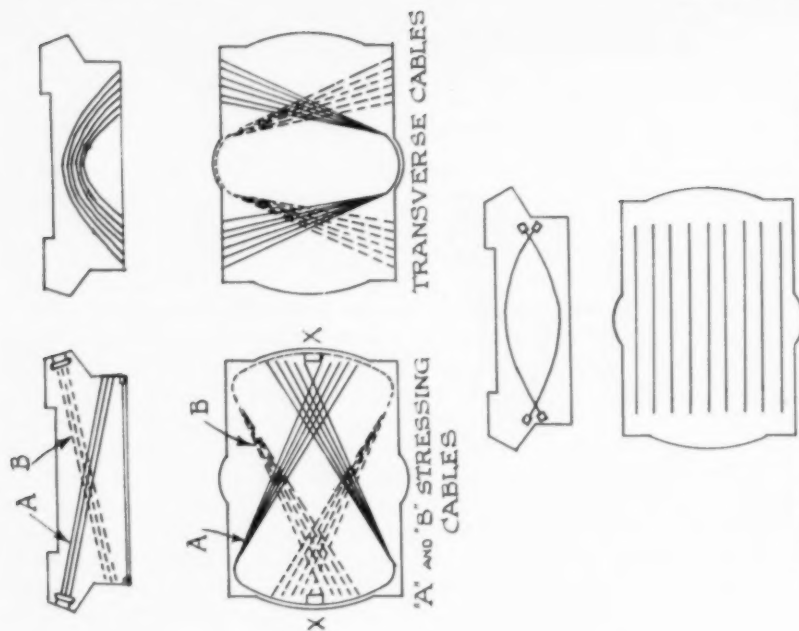
By ROLT HAMMOND, A.C.G.I., A.M.I.C.E.

THE forging-hammer foundation described in this article was designed by Mr. J. H. A. Crockett, B.Sc. (Eng.), A.M.I.C.E., for the International Nickel Company of Canada, at Huntington, West Virginia, U.S.A. The hammer is employed for the hot forging of nickel-alloy ingots and sometimes for the hot-cold working of nickel and nickel-copper blooms and billets, using superheated steam at high pressure and therefore imparting the greatest shock experienced in general forging practice. The hammer has an 8-tons tup and the foundation has been analysed for shock, vibrations, movements, and loads in all directions. The inertia blocks were prestressed in three directions simultaneously on the Freyssinet system.

The main requirement was that there must be no large ground vibrations. Consideration was given to the shock on the foundation at the moment of impact; the vibrations, loads, and movements in all directions due to impact; and to the fatigue of the concrete caused by the rapid reversals of stress. The arrangement is shown in *Fig. 1*. The upper and lower inertia blocks each weighs about 160 tons. The upper block is annular and mounted on four massive concrete legs which rest on the corners of the lower block so as to provide access to the laterally-disposed springs and other dampers and to the sides of the anvil-block and its springs. The sideways-acting rubber springs are on welded steel brackets, fixed to the lower block by high-tensile steel bolts which were prestressed by the Lee-McCall system. These bolts were tensioned to 30 tons per square inch, by jacks attached to their lower ends. The brackets were shimmed so that the springs have a precompression such that under oscillatory movement they will not become loose or chatter even when subjected to a heavy eccentric blow causing lateral and rotational movement of all the masses. The superstructure of the hammer and the anvil are in accurate relationship to one another, and cannot become out of true when they have been adjusted and after the initial and working creep of the rubber. The hammer, the foundation, and the adjacent ground act as a unit, and all these parts of the oscillating system are interrelated.

The length of the wave which travels through the anvil and the rest of the system is determined by the duration of the blow, the density of the material through which the wave travels, and the modulus of elasticity of the material. The length of the wave is only a few feet when the hammer is forging very hard nickel-alloy, and this very short wave creates problems of special difficulty. The wave is reflected and refracted from surfaces and boundaries in a similar manner to an extremely powerful sound wave. The shock-wave, on reaching the bottom of the anvil, is partly reflected back, but a small amount is refracted through the rubber spring into the concrete. Shock-waves in compression, when reflected from a concrete-air boundary, are in tension, and should any of these come to a focus at any point the resulting tensile stress would be sufficient to cause failure. The concrete blocks therefore have a shape which will cause the shock-waves to disperse rather than to come to a focus. Waves passing through concrete which is not uniform in quality have a greater velocity in the





CABLES IMPARTING VERTICAL STRESS  
Fig. 2.—Arrangement of Cables.

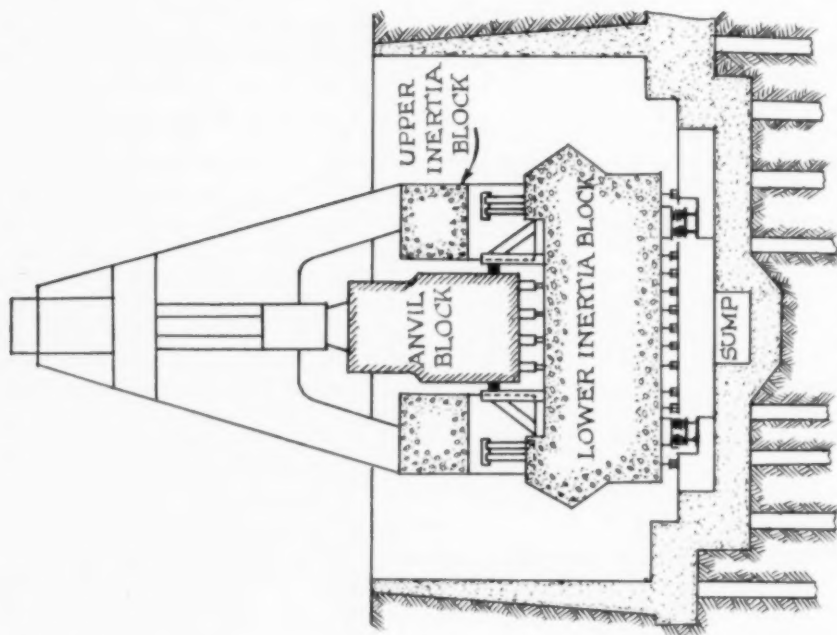


Fig. 1.—General Arrangement of Foundation.



better quality concrete than in the poorer, so setting up a difference in phase between the two parts of the wave. A strong shearing action is thus produced between the two which leads to disintegration. The concrete should therefore be as homogeneous as possible.

The fatigue strength of concrete is much lower when the stress is alternately tensile and compressive than when the stress varies in intensity but remains compressive. After ensuring the greatest possible isolation of the foundation the live load from the anvil was still about five times the dead load, and so it was decided to prestress the inertia blocks in three directions to maintain a state of compression within the concrete. In order not to disturb production, the existing concrete-lined foundation pit was enlarged and provided with a new bottom on the existing piles. At the level of the floor of the old pit a strong reinforced concrete frame was formed to resist the lateral earth thrust and the outward thrust due to the side springs on the lower inertia block. Cables A and B (*Fig. 2*), which impose forces along the major axis of the block, pass diagonally from one end of the block to the other, where they return through a curve of large radius to the end from which they started. By sloping these cables diagonally it was thought that they would also exert a vertical force on the block, but in addition, to increase the vertical force, further cables were placed along the major axis of the block, alternate cables being curved in opposing directions in a vertical plane. Two more sets of cables, disposed diagonally, provide the transverse forces. The cables pass through sheaths embedded in the concrete. In order to reduce losses due to friction at the bends, the cables were over-tensioned initially and during the prestressing, then allowed partly to slip back before being anchored. Cables A and B each had two bends of more than a right angle, and, as this method of tensioning would not provide uniform extension, two flat jacks were inserted at each end at the points marked X (*Fig. 2*), so that the middle of the curved portion of each cable would be pulled around the corners. *Fig. 2* refers to the lower inertia block, and the cables are arranged in a similar manner in the upper block.

The upper block has four strongly-reinforced concrete feet which rest partly on the overhanging parts of the lower block; for this reason the double-curved cables were placed around the corners of the lower block. Although the prestressing forces are sufficient to resist the calculated bending moments, mild steel bars were placed near the surfaces of each block in order to prevent development of fine hair cracks which might lead to failure as a result of fatigue. It was also thought that the cables might slip through the anchor-cones owing to the constant fluctuation of the dynamic stresses. For this reason, after tensioning, the wires forming the cables were threaded through a  $\frac{3}{8}$ -in. thick mild steel plate placed outside the male cones, and these plates, together with the cables, were grouted.

The aggregate for the concrete in the extension to the walls and bottom of the foundation pit was crushed dolomitic limestone and crushed limestone sand, the fineness moduli being 6.70 and 2.79 respectively. The proportions were 1 : 2.01 : 2.35 by weight, and the average crushing strength of 6-in. by 12-in. cylinders was 4837 lb. per square inch at 28 days. For the upper and lower inertia blocks a strength of about 4000 lb. per square inch was required at seven days.

A crushing strength of 10,000 lb. per square inch at 28 days has been attained

on 6-in. cubes, and 13,000 lb. per square inch at 128 days. The close spacing of the reinforcement and cables required concrete which could be easily placed. A high cement content was not desirable, due to the danger of excessive shrinkage. The method of concreting was first to fill the shuttering with dry or damp coarse aggregate and then fill the voids with grout through tubes  $\frac{3}{4}$ -in. diameter; this is known as the "Prepakt" method. The coarse aggregate was crushed

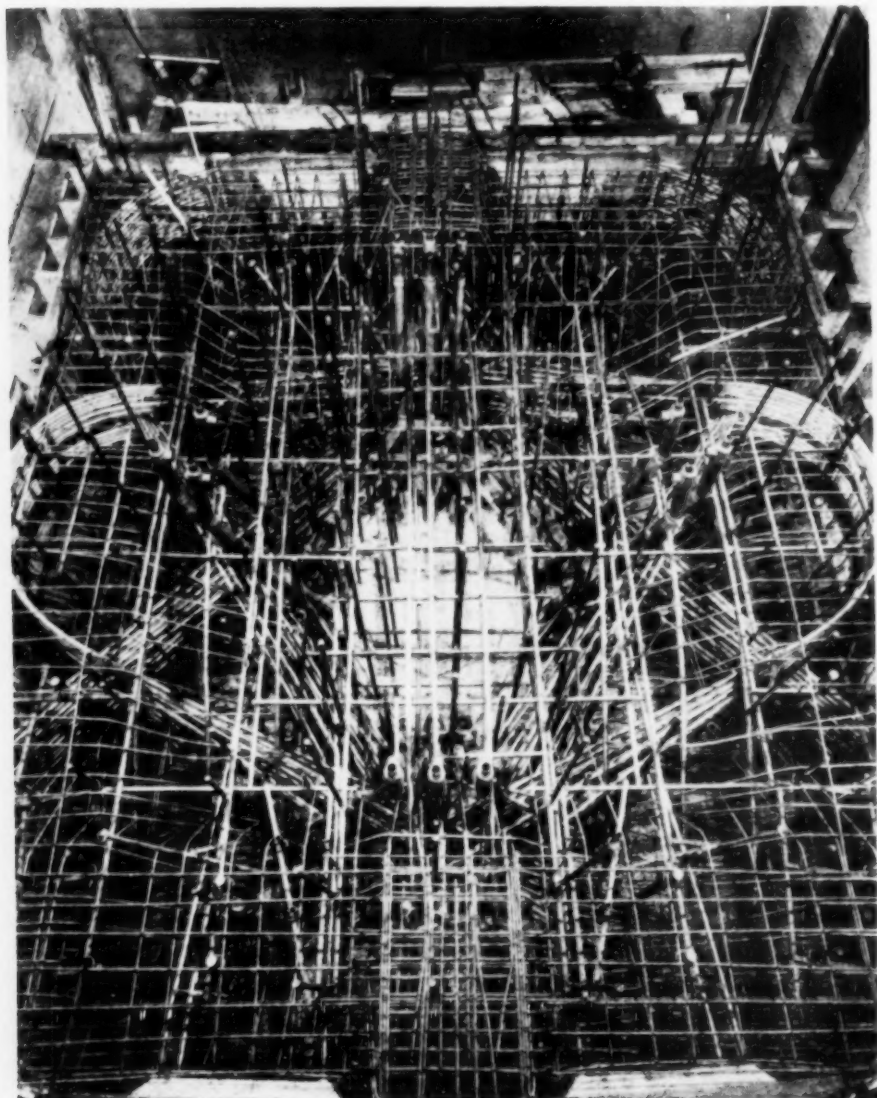
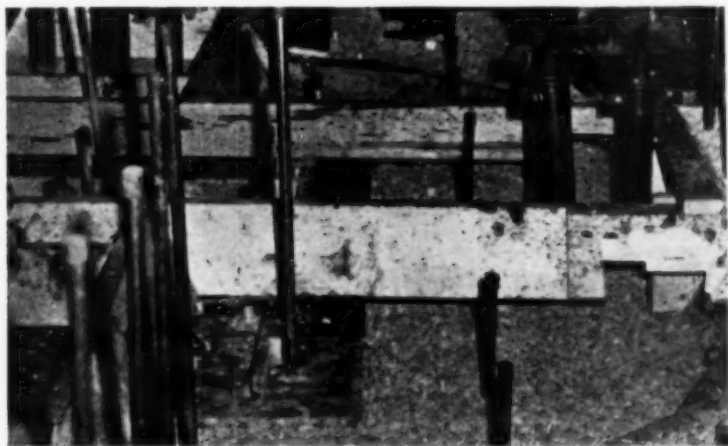


Fig. 3.—Prestressing Cables in Lower Inertia Block. Note Tops of Grouting Tubes.

limestone with a fineness modulus of 6.97. The grout was a mixture of Portland cement, finely-divided pozzolanic material, and sand in the proportions of 9:1:6. It is claimed that the pozzolana prevents agglomeration of cement particles and decreases "bleeding." Crushing tests on 12-in. by 6-in. cylinders gave the following strengths in lb. per square inch: Six days, 4010; 27 days, 5705; 180 days, 10,600.

The cables and reinforcement of the bottom inertia block are shown in *Fig. 3*. As the baseplates had to be set and levelled precisely, it was not possible for this to be done, and for the top steel to be placed, after concreting the bottom of the block without having a construction joint in the concrete. Similar grout to that used for the concrete was used for grouting the cables as its final setting time of 38 hours and its expansion of 11.6 per cent. by volume after three hours was particularly suitable for this purpose. Before constructing the inertia blocks



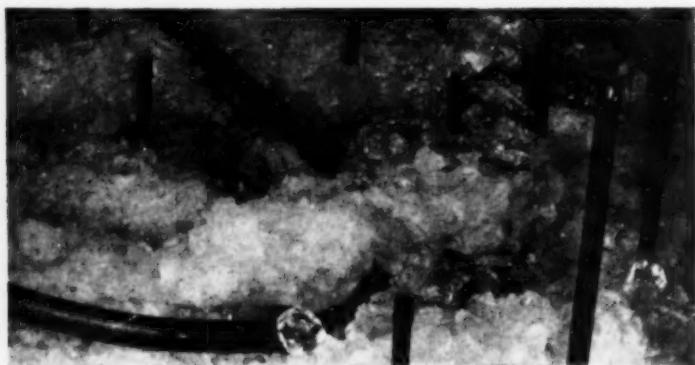
**Fig. 4.—Lower Inertia Block with Aggregate in place ready for Grouting.**

a model was made showing the reinforcement and cables. This enabled the steel-fixers to plan the work and saved considerable time.

Reconstruction of the foundation pit required about 135 cu. yd. of concrete and presented no particular difficulty other than that of placing concrete amongst closely-spaced reinforcement and using vibrators in confined spaces. After removal of the shuttering it was found that some areas were honeycombed, the most serious being in the piers supporting the dampers at each corner at the bottom level. Here it was necessary to remove about 6 in. from the top of each pier and to cut into the walls alongside the piers in order to form a key between the new concrete and the walls. *Fig. 3* shows the lower inertia block and the complex reinforcement; four sets of pipes were provided for draining condensate water through the lower inertia block to the sump. This water also acts as a coolant for the anvil, which becomes very hot. The anchor-cones and the housings for the steel springs were fixed to the shuttering. A view of part of the top of the lower inertia block is shown in *Fig. 4*, with the aggregate and

grouting pipes in position. The grout was pumped into the base of the block and gradually rose through the aggregate. The top surface was shuttered except for the areas occupied by the baseplates shown in *Fig. 4*. This shuttering consisted of parallel boards about  $\frac{1}{2}$  in. apart. A layer of expanded metal was laid on top of the boards, followed by a layer of fine wire mesh, the final covering being muslin. This top shutter allowed air and surplus water to escape, while providing a smooth surface.

The wires used in the cables have a carbon content of about 0.7 per cent., a yield stress of about 150,000 lb. per square inch, a tensile strength of about 210,000 lb. per square inch, and a Young's modulus of about 29,000,000 lb. per square inch. It was possible to tension the cables to 140,000 lb. per square inch; except in the case of one cable which was fixed at both ends by mortar, which entered the sheath during grouting of the aggregate. To allow for the loss of tension in the curved cables—amounting to nearly 40 per cent. in the case of cables A and B—these were generally over-tensioned by about 15 per cent.



**Fig. 5.—Crushed Ice above Aggregate.**

On the afternoon before grouting of the lower inertia block started, about  $5\frac{1}{2}$  tons of ice were spread over the top of the block and sprinkled with water (*Fig. 5*), the chilled water seeping through the aggregate and reducing its temperature to about 50 deg. F. by the next morning. Grouting started at 8 a.m. and proceeded until about 4 p.m., when the grout was within a few inches of the top. The need to increase the grouting pressure led to some mechanical trouble with the pumping equipment because the pressure required to force the grout under the baseplate was greater than that normally used. Pumping was continued with a standby single-stage pump, and as this was sufficient to supply only one feed-line grouting was not finished until about 10 a.m. the next morning (*Fig. 6*). In order to reduce the rise in temperature of the concrete, water was pumped through the drain-pipes in the central portion of the block throughout the grouting operation and for some time afterwards. Within three hours of completion of grouting, water was sprayed on the surfaces of the block, which were kept wet for several days. The top shuttering was removed on the second day after grouting and the remainder on the fourth day. Tensioning of the

cables was started nine days after grouting, by which time the concrete had a crushing strength greater than 4000 lb. per square inch.

The hammer was placed in service at the end of October, 1951, and has been working since for 24 hours a day, six days a week. The only unsatisfactory grouted concrete was that directly under the anvil baseplate. About two months after the hammer began work, the rubber springs under the anvil appeared to have shifted. The anvil was lifted and the rubber springs and baseplate removed, and it was found that although the surface of the concrete was hard it had in places been depressed by the steel plates slightly more than  $\frac{1}{2}$  in. This appeared to have been caused by the presence of froth which seems to be unavoidable



Fig. 6.—Grouting Plant over the Pit. The Pipes Extend Down to the Tops of the Tubes shown in Fig. 3.

in this type of grouted concrete, and is composed of air bubbles in a mixture of grout and water. This froth rapidly broke down under impact and was washed away by water coming through the drains from the condensate. The repair allowed the anvil to be jacked up without dismantling the hammer. The concrete was chipped out to a depth of about 6 in. without disturbing the reinforcement, and the chipped surface was sand-blasted. Using additional reinforcement, a concrete platform  $5\frac{1}{4}$  in. high was constructed to support the baseplate. The mixture used for this concrete was 1 : 1.5 : 1.9 by weight with rapid-hardening Portland cement, and having a compressive strength of 6400 lb. per square inch at 28 days. After three days the surface of this platform was ground to within 0.03 in. of true flatness and treated with a proprietary hardening compound.



## Towers for Drying Fire Hoses.

THE towers for drying fire hoses shown in Fig. 1 consist of three slender prestressed concrete uprights 30 ft. high with a three-armed precast bracket at the top, from which the hoses are hung. The masts are each made of fourteen precast sections and are arranged to form, on plan, a triangle with sides of 3 ft. Triangular diaphragms, which connect

the three uprights at intervals, alternate with these sections and both uprights and diaphragms are pierced with ducts for the passage of Freyssinet prestressing cables. The cable ducts continue into the solid concrete base of the tower and curve outwards at the bottom to allow the cables to emerge from the sides of the base block, where they are tensioned and anchored.

A. & C. Buildings, Ltd., who designed the towers in collaboration with the County Architect, Mr. H. Conolly, cast and supplied the parts and carried out the erection and prestressing of a prototype tower. Erection and prestressing of subsequent towers is to be done by the Essex County Council's Fire Brigade Maintenance and Building Department.

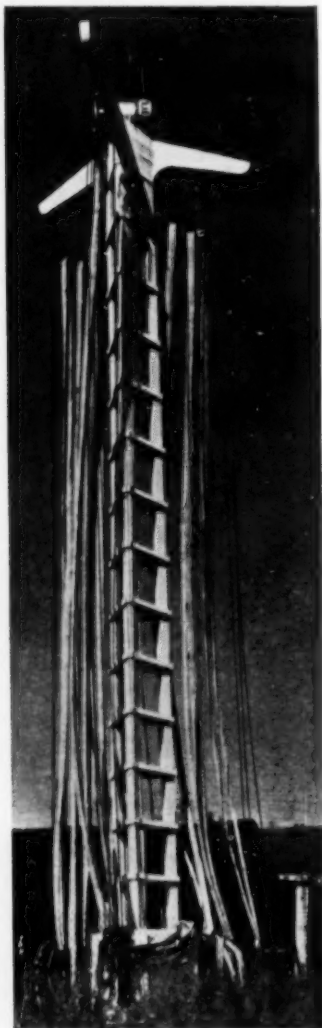


Fig. 1.

## Corrosion of Steel in Concrete Pipes.

ACCORDING to "Engineering News-Record" (19 February, 1953) work has been stopped on a contract for making and laying 37 miles of prestressed concrete pipes at Regina, Canada, because it has been found that in some cases the prestressing wire was corroded. The contractors claim that the corrosion is due to the fact that the concrete, which was specified for use in the heavy gumbo clay of the district, contained an admixture to increase the resistance of the concrete to alkalis and calcium chloride to hasten setting. The contractors suggest that these admixtures be omitted and that the pipes be coated with asphalt or other protective cover.

## Standard for Slag Aggregates.

THE British Standard for Air-Cooled Blastfurnace Slag Coarse Aggregate for Concrete (No. 1047: price 4s.) has been revised to provide for the use of this class of aggregate in no-fines concrete, and now includes a grading of blastfurnace slag aggregate suitable for no-fines concrete. The methods of taking samples and of carrying out tests have been brought into line with B.S. No. 812, "Methods for the Sampling and Testing of Mineral Aggregates", and the gradings are now the same as for other aggregates.

## A Factory for Prestressed Concrete in Argentina.

A LARGE factory for manufacturing prestressed precast concrete products has recently been constructed at Sierra Chica, about 200 miles from Buenos Aires, Argentina. The factory is described in a recent number of the journal "Hormigon Elastico."

The method of manufacture is a long-line process known as the "Zofra" sys-

tem and cantilevered from the columns supporting the roof are platforms extending the whole length of the beds and on which are benches for assembling cages of reinforcement, etc. (Fig. 2).

In the part of the factory adjacent to the prestressing beds (marked 2 on Fig. 1) the prestressed elements are assembled into the finished products. This portion

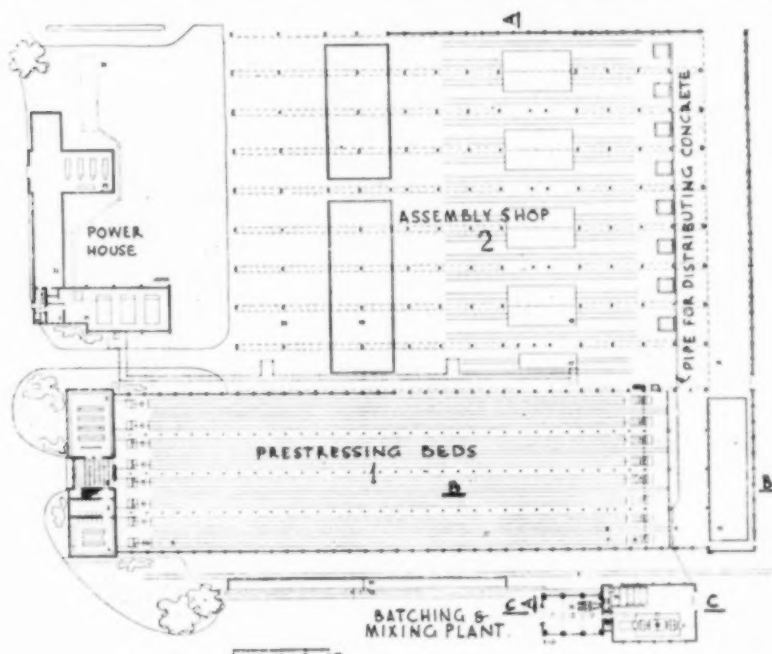


Fig. 1.—Plan.

tem, designed by M. Zorislav Franjetic, in which a small variety of tubular elements is made which may be assembled to form beams, pipes, posts, and other members.

The arrangement of the factory is shown in Figs. 1, 2, and 3. The casting and prestressing beds are in the portion of the factory marked 1 on Fig. 1; this portion is 407 ft. long by 108 ft. wide and each of the eight beds is 328 ft. long. The beds are provided with steam pipes for curing the concrete. Above the beds

is 213 ft. long and is divided by columns into nine bays each 27 ft. wide, each bay having a travelling crane. Also in this part are five autoclaves, four 49 ft. long and one 39 ft. long, and two large tanks for curing the products in water.

Adjoining the prestressing bays are the batching and mixing plant and the pumps for distributing the concrete. The aggregate is delivered by rail to the yard adjacent to the batching plant and is then transported by conveyor belts to the screens where it is graded into four sizes.



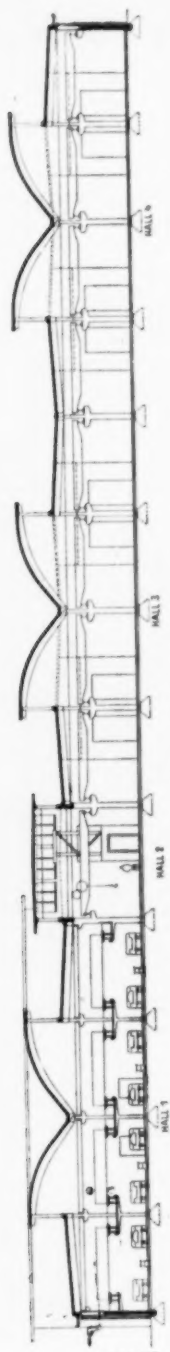


FIG. 2.—SECTION AA.

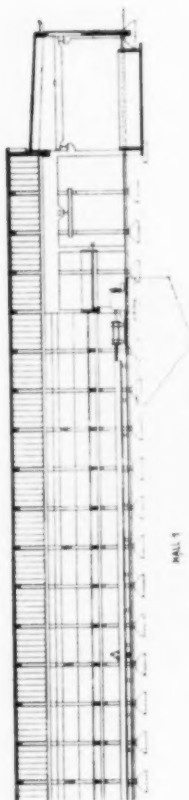


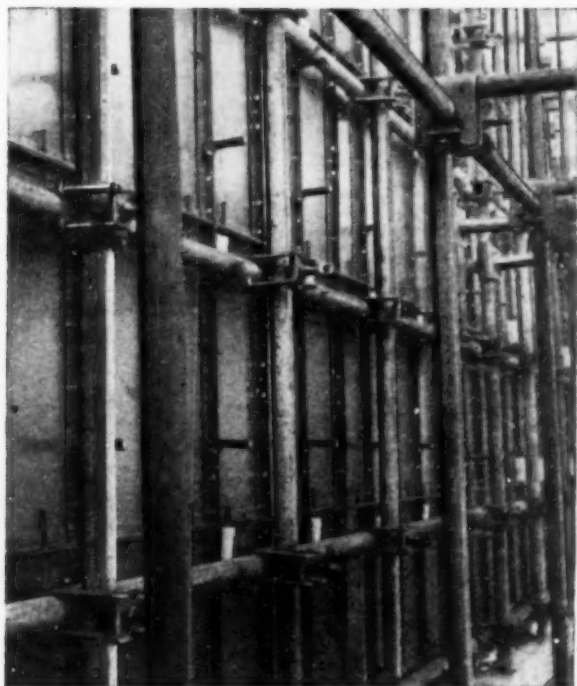
FIG. 3.—SECTION BB.  
Prestressed Concrete Factory in Argentina.

# STEEL FORMS

The Multiple System of Interlocking

## STEEL SHUTTERING

for in-situ concrete construction



**GUARANTEED HAND RIVETED CONSTRUCTION  
THROUGHOUT**

ENORMOUS STRENGTH ALTHOUGH LIGHT IN WEIGHT

ENGINEERED WITH ACCURACY AND PRECISION

BUILT LIKE A SHIP FOR ENDURANCE

EACH UNIT A COMPLETE ASSEMBLY

NO LOOSE PARTS — LOW MAINTENANCE

POSITIVELY NO WELDING

YEARS OF HEAVY USAGE

**A. A. BYRD AND CO., LIMITED**

210, Terminal House, Grosvenor Gardens, London, S.W.1

'Phone: SLOane 5236.

'Grams: Byrdicom, Wesphone, London.

# "Ritecure"

THE RIGHT CURE FOR CONCRETE

## MEMBRANE CURING

for horizontal and vertical surfaces

### "RITECURE"

#### MEMBRANE CURING

#### Further Notable Points

- RITECURE reacts with the calcium radical to aid in producing the tough, impervious, adherent film.
- RITECURE increases the abrasive resistance and ultimate durability of the concrete surface.
- RITECURE, colourless and non-staining, contains a temporary green indicator. This colour disappears in a day or two.



This illustration shows part of several miles of concrete kerbing on which "RITECURE" was used. Note the simple and one-man operation, and the absence of covering materials. This work was carried out by the County Council of the West Riding of Yorkshire. County Engineer: Mr. S. Maynard Lovell, O.B.E., T.D.

RITECURE is sprayed on the concrete surface and forms a cellophane-like skin which ensures the retention of the maximum amount of moisture in the concrete. It has been effectively and economically used on over eight million yards of roads, runways, floors, cooling towers, and other structures in this country and for many million yards of concrete abroad in extremely high and low temperatures and varying climatic conditions. Its use is backed by a highly skilled Technical Service with an extensive experience in concrete curing. For full details, send to:

# STUART B. DICKENS, LTD.

26 VICTORIA STREET,  
WORKS: OLD MILTON STREET,

LONDON, S.W.1.  
LEICESTER.

TELEPHONE: ABBEY 4030  
TELEPHONE: LEICESTER 20390

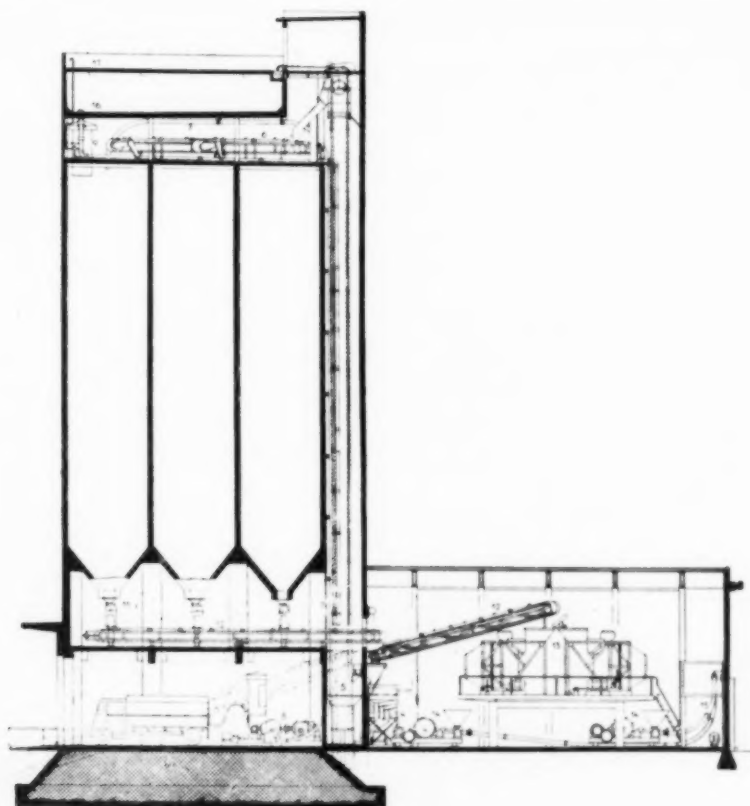


Fig. 4.—Section CC.

The screened material is lifted by elevators to the silos (*Fig. 4*). There are six silos, about 100 ft. high, over the grading plant; four of these are for aggregate and two for cement. On top of the silos is a water storage tank. The dry materials are weigh-batched and carried to the two 2-cu. yd. mixers by belt conveyors. The concrete is distributed to the casting beds and the assembly shop by a concrete pump situated directly below the mixers and a pipe extending along one side of the factory.

The electrical power and the steam re-

quired in the factory are produced in the power station to the left of the assembling shop.

The factory is of reinforced concrete and is situated in a village built for the workers. The village contains 310 houses and is provided with an administrative centre, a church, shops, a cinema, a clinic, a swimming pool and a sports ground. The factory was designed by Mr. Franjetic in collaboration with Messrs. Juan Fusek, R. Arendt, and Helmut Kloss. The architect was Mr. Luis M. Stigler.

# Prestressed Precast Frame for Elevated Tanks.

THE structure shown in *Fig. 1* for supporting three elevated tanks, each 30 ft. long by 9 ft. diameter, with a total weight of nearly 150 tons when full, has been completed at the Shell-Mex and B.P. oil installation at Dingle Bank, Liverpool.

The main supports for the tanks com-

the length of the tanks to give stability transversely to the main beams. Mild-steel loops protrude from the tops of the columns and the ends of the beams into joints which were filled with concrete to tie the beams and columns together at the level of the platform.

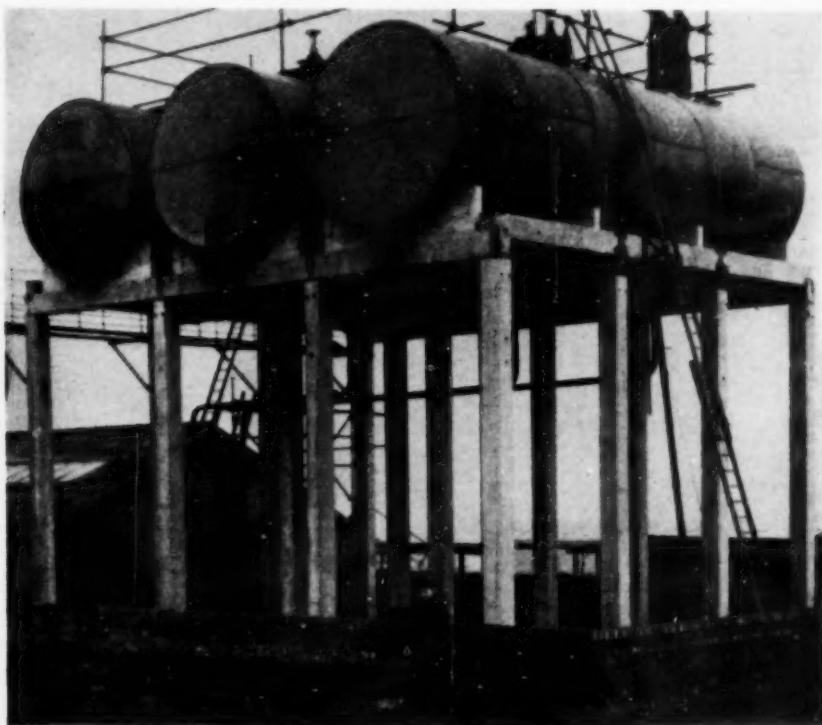
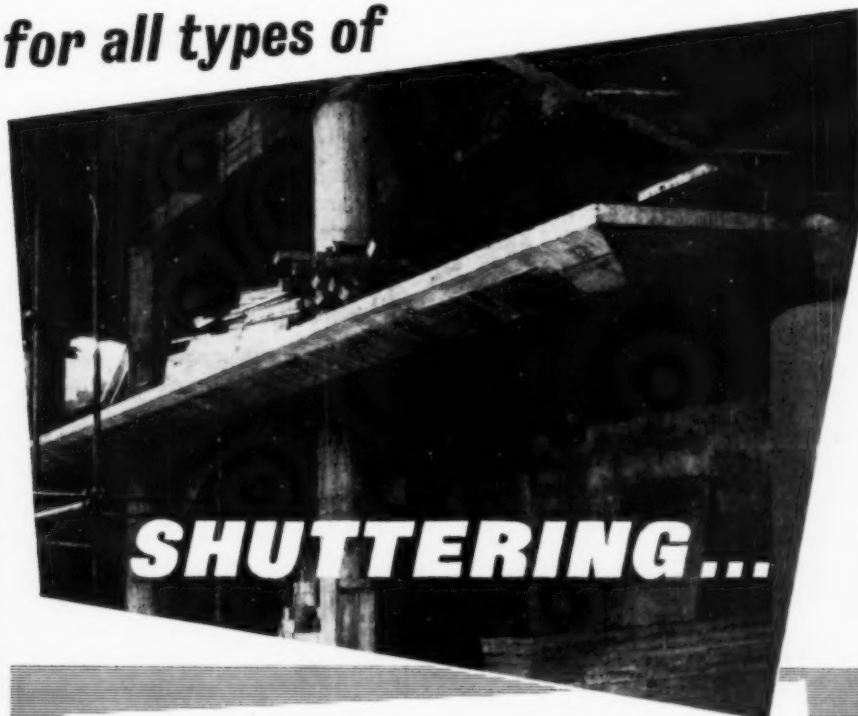


Fig. 1.

prise sixteen prestressed precast columns, 1 ft. square, set in pockets in reinforced concrete bases. There is no diagonal bracing and the columns resist wind loads as cantilevers about the bases. The tanks are carried on concrete cradles (which were cast at the site) resting on twelve prestressed precast beams 1 ft. 2 in. deep by 10 in. wide which span between the tops of the columns. Prestressed precast beams are also provided between the two outer rows of columns parallel to

The precast columns and beams were designed and made by the Concrete Development Company, Ltd., using 2-mm. wires, on a pre-tensioned long-line process. The concreting at the site and the erection of the structure were carried out by Messrs. Holland & Hannen and Cubitts, Ltd. The total amount of steel used was 14 tons, and it is stated that had the structure been built in reinforced concrete 18½ tons of steel would have been required.

**for all types of**



**tubular scaffolding &  
builders plant  
contract or hire**

**-try SGB**

**SCAFFOLDING (GREAT BRITAIN) LTD**

**MITCHAM**

**SURREY**

Telephone: MITCHAM 3400 (18 lines) Telegrams: SCAFCO, MITCHAM

*Depots & Branches in all Principal Towns & Cities, Ireland & South Africa*



*-the originators of tubular scaffolding!*

## MISCELLANEOUS ADVERTISEMENTS.

*Situations Wanted, 3d. a word: minimum 7s. 6d. Situations Vacant, 4d. a word: minimum 10s. Other miscellaneous advertisements, 4d. a word: 10s. minimum. Box number 1s. extra. The engagement of persons answering these advertisements is subject to the Notification of Vacancies Order, 1952.*

**Advertisements must reach this office by the 23rd of the month preceding publication.**

## SITUATIONS VACANT.

**SITUATION VACANT.** Required for consulting engineer's office, experienced detailer for reinforced concrete work. Good draughtsman with drawing-office experience in all types of reinforced concrete, and precast concrete also if possible. Salary according to age and experience. Please write, giving all details, to F. J. SAMUELY, 8 Hamilton Place, London, W.1.

**SITUATION VACANT.** Consulting structural engineer, Westminster, requires senior designer-draughtsman with first-class experience in reinforced concrete for responsible position. Experience in structural steelwork an advantage. High salary and good prospects for suitable applicant. Write in confidence stating age, qualifications, and full details of experience. Box 3639, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

**SITUATION VACANT.** Reinforced concrete detailer required. Permanent and progressive post. Some previous experience and good drawing essential, but opportunity to obtain experience in prestressed and other structural design. Write DONOVAN LEE, M.I.C.E., Consulting Engineer, 66 Victoria Street, London, S.W.1.

**SITUATIONS VACANT.** Designer-detailers required by consulting engineers for their Newcastle-upon-Tyne office. Applicants should have had previous experience of heavy reinforced concrete industrial foundations, structures, and other civil engineering works. Appointments offer chances to secure sound and extensive experience, and will carry good salaries and prospects according to experience and ability. Apply, giving full particulars of qualifications, training, and experience, together with a statement as to salary required, to Box 3645, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

**SITUATION VACANT.** Engineering draughtsman required at Feltham, Middlesex, with commercial experience in reinforced concrete design, especially floors. Write experience and salary required to Box 3644, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

**SITUATIONS VACANT.** Imperial Chemical Industries Limited, General Chemicals Division, require general civil and structural designer-draughtsmen to assist in the design of steel and reinforced concrete structures for chemical plants. Location: Runcorn. Salary dependent on age and experience. Apply in writing, quoting E/83, to STAFF MANAGER, IMPERIAL CHEMICAL INDUSTRIES LIMITED, General Chemicals Division, Cunard Building, Liverpool, 3.

**SITUATION VACANT.** Senior reinforced concrete engineer required for Midland office of reinforced concrete specialists. A qualified man of wide experience is required, capable of controlling drawing office staff. Salary according to ability but not less than £1,000 per annum. Apply Box 739, 19/21 Corporation Street, Birmingham 2.

**SITUATION VACANT.** Designer-draughtsman required by specialist manufacturers of steel shuttering and moulds. Knowledge of these matters preferable. Good prospects for right man. Salary according to experience. Box 3646, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

**SITUATION VACANT.** THE TRUSSED CONCRETE STEEL CO., LTD., Truscon House, 35-41 Lower Marsh, London, S.E.1, have a vacancy in their London office for a measurer with experience in the taking-off and preparation of bills of quantities mainly for reinforced concrete structures. Age 25-30. Five-days' week and pension scheme. Apply in writing to the above address, giving full particulars of age, education, and previous employment.

**ACROW**  
(ENGINEERS) LTD

## SENIOR DRAUGHTSMEN

wanted, preferably experienced in application of Steel Shuttering to reinforced concrete structures or, alternatively, with a background of structural engineering which could be applied to such work.

Excellent prospects of promotion, at home or abroad, with an ever-expanding company where ability, initiative and ambition mean sure advancement.

*Write, stating age, experience and salary required, to:—*

**ACROW (ENGINEERS) LTD.**  
South Wharf, London, W.2

*Every bona-fide applicant is guaranteed an interview*

**SITUATION VACANT.** Planning assistant with previous experience in costing, estimating, or progress work in building, civil engineering, precast concrete, or allied industries. This vacancy offers excellent scope for a young man of about 25-30 who has ability and can work. Apply BECHAM BUILDINGS, LTD., Reinforced Concrete Engineers, Shipston-on-Stour, Warwickshire.

**SITUATIONS VACANT.** THE TRUSSED CONCRETE STEEL CO., LTD., Truscon House, 35-41 Lower Marsh, London, S.E.1, have vacancies in their London, Birmingham, Glasgow, and Manchester offices for designers and designer-detailers with considerable experience in reinforced concrete D.O. work. Five-days' week and pension scheme. Apply in writing to the above address, giving full particulars of age, education and previous employment.

**SITUATIONS VACANT. NORTH THAMES GAS BOARD.**—The following Drawing Office staff are required in the Chief Engineer's department. (i) At Beckton, E.6, Bromley-by-Bow, E.3, Lea Bridge, E.10, Mill Hill, N.W.7, and Kensal Green, W.10—Draughtsmen experienced in the maintenance of gas manufacturing and ancillary plant. Starting salary within the range £370-£600 per annum. (ii) At Westminster, S.W.1—(a) Senior Draughtsmen experienced in the design of gas manufacturing and ancillary plant, including steel-frame structures. Starting salary within the range £645-£795 per annum. (b) Draughtsmen experienced in the layout and detailing of gas manufacturing and ancillary plant, including steel-frame structures. Starting salary within the range £520-£695 per annum. (c) Draughtsmen for detailing reinforced concrete structures. Experience in design would be an added advantage. Starting salary within the range £520-£695 per annum. All these appointments are of a permanent nature, and successful candidates will be required to join the staff pension scheme. Starting salaries within the ranges mentioned will be dependent on age and qualifications. Applications, giving full particulars, should be sent to the STAFF CONTROLLER, NORTH THAMES GAS BOARD, 30 Kensington Church Street, London, W.8, to reach him not later than ten days after the publication of this advertisement and quoting reference 666/63.

(Continued on p. 157.)



(Continued from p. lii.)

**SITUATION VACANT.** Position available for technical assistant works manager with experience in prestressed and reinforced concrete. Attractive prospects for suitable candidate. Technical qualifications not essential but preferred. Apply, with full particulars of experience and salary required, to **ANGLIAN BUILDING PRODUCTS, LTD.**, Atlas Works, Lenwade, Norwich.

**SITUATION VACANT.** Old-established Tees-side firm requires section-leader reinforced concrete designer-draftsman, fully experienced in designing and detailing reinforced concrete structures, foundations, and other civil engineering work. Apply, giving full particulars and experience, quoting D, to Box 3647, **CONCRETE AND CONSTRUCTIONAL ENGINEERING**, 14 Dartmouth Street, London, S.W.1.

**SITUATIONS VACANT.** Reinforced concrete engineers require designer-draftsmen, preferably A.M.I.Struct.E., for work at Bristol or near London. Opportunity to widen experience. Good salary to right men. Box 3648, **CONCRETE AND CONSTRUCTIONAL ENGINEERING**, 14 Dartmouth Street, London, S.W.1.

**SITUATION VACANT.** Consulting engineer requires senior reinforced concrete designer to take charge of design and administration of contract in drawing office. Position offers scope for organising ability, and some previous site experience and knowledge of engineers' quantities would be an advantage. Applicants should be Corporate Members of the Institution of Structural Engineers, or have equivalent experience. Write, stating age, experience, and salary required, to Box 3649, **CONCRETE AND CONSTRUCTIONAL ENGINEERING**, 14 Dartmouth Street, London, S.W.1.

**SITUATION VACANT.** The services of a further detailer-draftsman are required by consulting engineers who have filled previously-advertised situations and are further expanding. The work covers mainly structures in connection with coal preparation plants. The position available is a progressive one and has possibilities for a "live" young man who is keen to get experience. Applicants should be preferably to H.N.C. standard and have Institution of Structural or Civil Engineers examinations in mind. 5-days' week. Write, stating age, experience, and salary required, to **J. C. HUGHES & PARTNERS**, 119 Marylebone Road, London, N.W.1.

**SITUATION VACANT.** Technical assistant required at concrete depot in Manchester area by British Railways. Must have ability to control staff, plan output, and prepare formwork details. Knowledge of elements of reinforced and prestressed concrete desirable. Commencing salary £612 ss. per annum. Certain residential and free travelling facilities given. Apply **CIVIL ENGINEER**, BRITISH RAILWAYS, LONDON MIDLAND REGION, Euston Grove, London, N.W.1.

**SITUATIONS VACANT.** Structural engineering designer-draftsmen required in London in Designs Branch of Air Ministry Works Department. Applicants should have several years' experience in design and detailing of reinforced concrete or structural steelwork. Salaries in ranges up to £733 per annum, starting pay dependent upon age, qualifications, and experience. Overtime and extra duty allowance payable. Apply, quoting Order No. Borough 3674, MA., stating age, qualifications, and previous appointments (with dates), to any Employment Exchange.

**SITUATION VACANT.** Reinforced concrete designer-draftsman for consulting engineer's office, North London. Good salary and good prospects. Interesting all-round work. Apply to **L. J. ELGIN, A.M.I.C.E.**, 47 Clarendon Court, London, N.W.11. Telephone: Mountview 5083.

**SITUATION VACANT.** Required for consulting engineer's office, tracer with a minimum of two years' experience in structural drawing. Salary according to age and experience. Please apply in writing, giving all details, to **F. J. SAMUELY**, 8 Hamilton Place, London, W.1.

**SITUATIONS VACANT.** Ove Arup & Partners require several reinforced concrete designer-detailers. Apply in writing giving full particulars of education, training, and experience, and stating salary required, to above at No. 8 Fitzroy Street, London, W.1.

(Continued in next column.)

## Books Received.

**"The Study of Road Subgrades."** By A. E. Oliveira. (Lisbon: Ministry of Public Works. 1951. No price stated.)

**"Medição de Deformações com Extensómetros Mecânicos."** By J. D'Árga e Lima. (Lisbon: Ministry of Public Works. 1951. No price stated.)

**"Building Construction." Volume I.** By W. B. McKay. Third Edition. (London: Longmans, Green & Co. 1951. Price 12s. 6d.)

**"Principles and Practice of Prestressed Concrete."** Vol. 1. Second edition. By P. W. Abeles. (London: Crosby Lockwood & Son, Ltd. 1952. Price 21s.)

**"A Survey of the Behaviour in use of Asbestos-Cement Pressure Pipes."** By F. E. Jones and J. P. Latham. (H.M. Stationery Office. Price 2s. 6d.)

**"Structural Steelwork for Buildings."** By H. P. Smith. Revised edition. 1952. (London: Crosby Lockwood & Son, Ltd.)

(Continued from column 1.)

**SITUATION VACANT.** Resident engineer required to supervise construction of large reinforced concrete office building in London, W.C.1. A chartered civil or structural engineer preferred. Must be experienced in supervising first-class work. Reply giving full details of experience and stating salary required to Box 3650, **CONCRETE AND CONSTRUCTIONAL ENGINEERING**, 14 Dartmouth Street, London, S.W.1.

**SITUATION VACANT.** Designer-draftsman required by Westminster consulting engineer, preferably with experience of river and dock work. Apply giving full particulars, and salary required, to **T. F. BURNS & PARTNERS**, 25 Victoria Street, London, S.W.1.

**SITUATION VACANT.** Concrete research engineer. The Stanton Ironworks Co., Ltd., proposes to appoint a young man with civil engineering experience prepared to take a keen interest in concrete research and quality control in respect of normally reinforced and prestressed concrete. The appointment carries excellent prospects, and the post is superannuated. Write in confidence to the **STAFFING OFFICER, THE STANTON IRONWORKS CO., LTD.**, near Nottingham, stating in detail age, qualifications, and experience.

**SITUATIONS VACANT.** The British Reinforced Concrete Engineering Co., Ltd., require several qualified designers and detailers with specialist experience for their Stafford, Bristol, Glasgow, London, Newcastle-upon-Tyne, and Dublin offices. Five days' week, and staff pension scheme. Apply to **B.R.C. ENGINEERING CO., LTD.**, Stafford.

## PROFESSIONAL SERVICES.

**PROFESSIONAL SERVICES.** Reinforced concrete designer-draftsman with 20 years' experience in the design of reinforced concrete structures, foundations for heavy industrial structures, chemical plant, and oil refineries, undertakes to prepare complete designs, calculations, and working details to help consulting engineers. Excellent references, moderate fee. Box 3637, **CONCRETE AND CONSTRUCTIONAL ENGINEERING**, 14 Dartmouth Street, London, S.W.1.

## FOR HIRE.

**FOR HIRE.** Lattice steel erection masts (light and heavy), 30 ft. to 150 ft. high, for immediate hire. **BELLMAN'S**, Terminal House, London, S.W.1. Telephone: Sloane 5259.

## FOR SALE.

**FOR SALE.** Sacks, bags, and curing cloths for sale. You want the best type and quickest delivery. Write **JOHN BRAYDON, LTD.**, 26 The Highway, London, E.1. Telephone: ROYAL 1044.

**FOR SALE.** Steel angle fencing stakes. All sizes in stock. List on request. **E. STEPHENS & SON, LTD.**, Bath Street, London, E.C.1.

**FOR SALE.** Concrete mixer. Capacity 10/7 with Bamford engine. **F. J. EDWARDS, LTD.**, 359 Euston Road, London. Telephone: EUSTON 4681.

## Prefabricated Reinforcement.

THE framework of reinforcement shown in *Fig. 1* has been designed and erected in accordance with a system recently introduced which, it is stated, reduces the time required for the fixing of reinforcement on the site to one-twelfth of that needed by the usual methods. It is also claimed that the weight of steel required is reduced by the elimination of hooks or other anchors at the ends of the bars where these have stirrups welded to them.

to the supporting flats by  $\frac{1}{4}$ -in. diameter hook-bolts passing over the tops of the bars and through mild steel flats under the supporting flats. Alternatively, pieces of 10-gauge wire 3 in. or 4 in. long may be welded to the flats before these are fixed in position and the ends of the wires turned around the bars as these are placed.

Connections between consecutive lifts of column bars are made by welding 1-in. by  $\frac{1}{4}$ -in. flats to the lower column

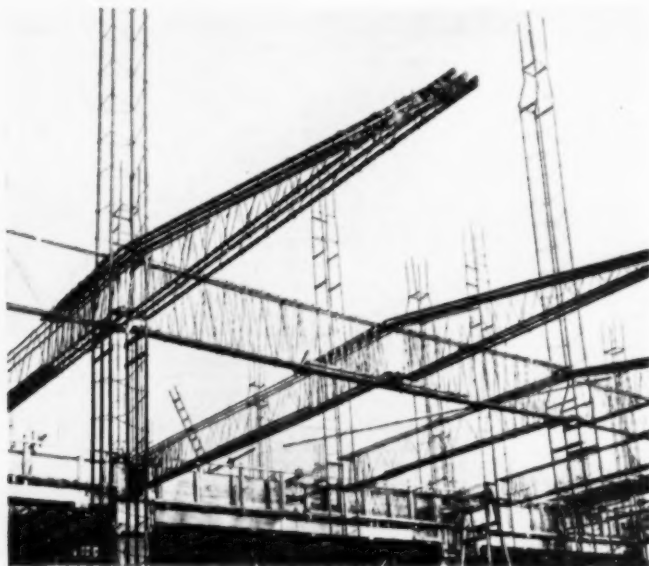
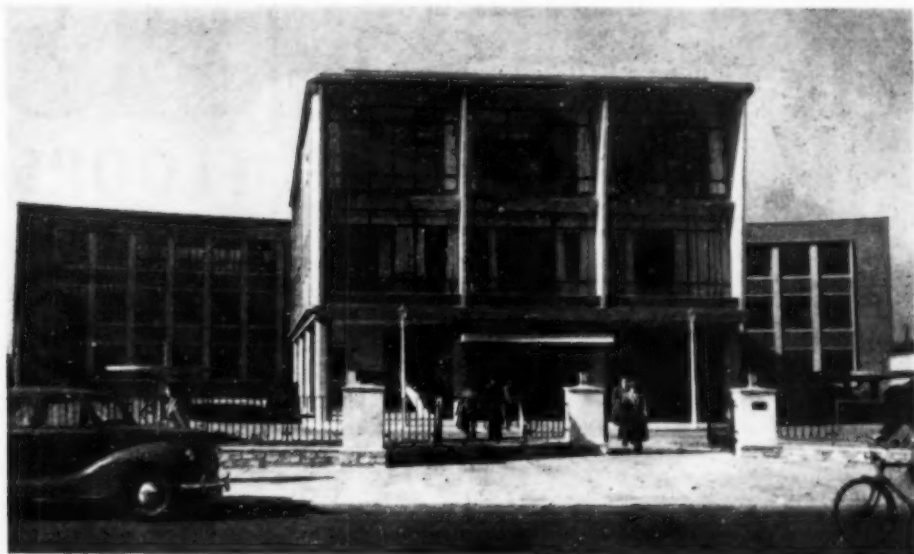


Fig. 1.—Reinforcement Erected.

The method, which is known as the "Frameweld" system, consists of the prefabrication in a workshop of welded cages of reinforcement which are erected on the site in the manner of structural steelwork. The columns comprise main bars with a continuous binding welded at each intersection with the main bars. The columns are provided with 1-in. by  $\frac{1}{4}$ -in. mild steel flats welded to the main bars to support the reinforcement of the beams (*Fig. 2*). The top edges of the flats may be grooved to receive these bars and ensure that they are in their correct position. The beam reinforcement is connected

bars at the level of the bottom of the crank where the main bars are lapped and to the bars of the upper column about 1 in. from their lower ends. The bars in the upper column are then supported by two more flats placed across those of the lower column and attached to them by being welded to washers 1 in. square kept in position by hook-bolts on the lower flats.

The beam reinforcement comprises a number of separate units each consisting of upper and lower bars joined by a diagonally-inclined continuous stirrup welded to the longitudinal bars. Trans-



333 Simplex Cast-in-situ Concrete Piles were used in the foundations of the Municipal College Extensions in Anglesey Road, Portsmouth

Architect to the City of Portsmouth: F. Mellor, Esq., F.R.I.B.A.

*Write for Illustrated Brochure*

## **SIMPLEX CONCRETE PILES LTD.**

25 BRECHIN PLACE,

SOUTH KENSINGTON,

LONDON, S.W.7

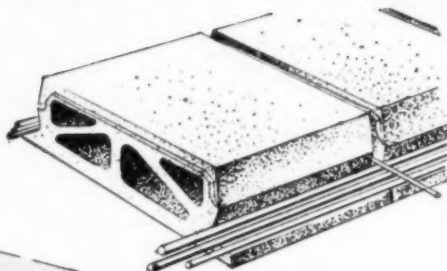
Telephone: Fremantle 0035-6



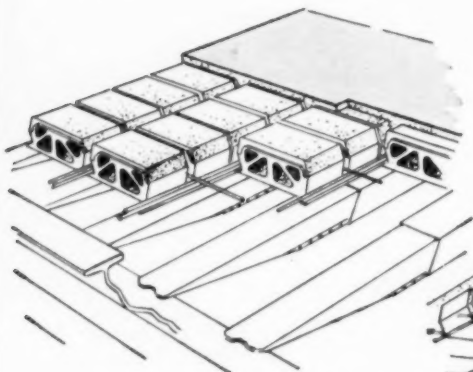
# SMITH'S

## FIREPROOF FLOORS

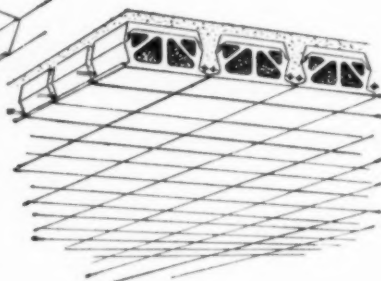
The most adaptable System of  
Suspended Hollow Concrete  
Floor and Roof Construction  
for large and small spans.



Showing Two-way Reinforce-  
ment and Hollow Concrete  
Blocks laid on Trianco Tele-  
scopic Centers.



Showing uniform concrete soffit.  
Obtained without use of slip tiles.



**2 WAY REINFORCED  
SUSPENDED  
CONCRETE FLOORS**

The Two-way Reinforced Floor for  
distribution of point loads with  
efficiency and economy, employing  
the original system of steel Telescopic  
Centers.

SMITH'S FIREPROOF FLOORS LTD  
IMBER COURT • EAST MOLESEY • SURREY  
EMBerbrook 3300 (4 lines)



Fig. 2.—Supports on the Column Bars for Beam Reinforcement.

verse stirrups are not used, and this enables the concrete to be more easily compacted. Distance-pieces are used to maintain the spacing of the reinforcement in the shutters. The standard units have stirrups inclined at 60 deg. or 45 deg., but additional shear reinforcement can be provided by increasing the angle of inclination of the stirrups or their diameter (*Fig. 3*). If more than one layer of bars is required in any portion of the beam the additional reinforcement is welded to the stirrups when fabricating the cage (*Fig. 3*).

Reinforcement over the supports of

continuous beams is not made in cage form as this would lead to difficulty in fixing. The bars are supplied loose and supported on flats welded to the column bars as well as being tied to the top bars of the beam reinforcement (*Fig. 2*). Transverse ties are used at intervals to keep the bars properly spaced.

The shuttering may be supported by props in the usual manner or be carried by steel channels bearing on the concrete of columns already cast.

In order to determine the effectiveness of the reinforcement when hooks, transverse stirrups, and diagonal bars were

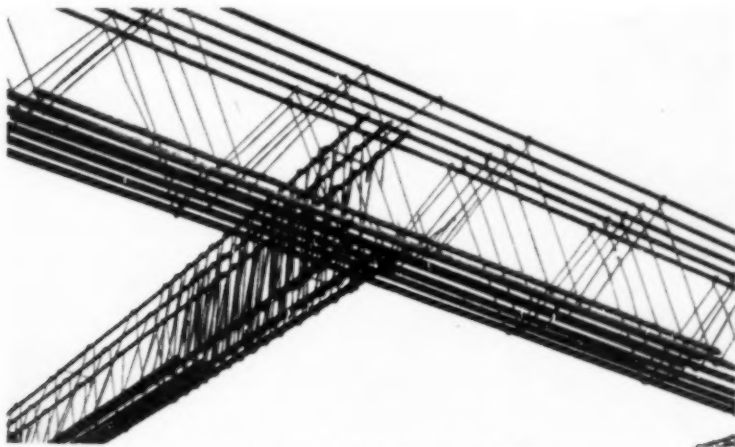


Fig. 3.—Additional Main Bars and Stirrups.

omitted, tests were made at the Building Research Station of twenty-four beams, eight reinforced in the ordinary way and sixteen with welded frames of the form described. The beams were 12 in. deep by 6 in. wide. One-half of the beams in each group was 10 ft. 6 in. long and the others 5 ft. 6 in. The beams were loaded at one-third points, and over a span of 10 ft. there was no significant difference in the strength or deflection of the two types of beams. The beams with the welded cages of reinforcement had no shear reinforcement additional to the diagonally-inclined stirrups, and consequently on the shorter span

they failed under a smaller load than the normally-reinforced beams provided with shear reinforcement. The tests showed that the bond strength of bars with stirrups welded to them was as great as that of hooked bars with loose stirrups.

The system has been designed by Messrs. T. C. Jones & Co., Ltd., and used by them for several structures including extensions of factories, a seven-story office building in London, and new laboratories at St. George's Hospital, London. The system has also been used in the construction of raft foundations on a housing site in Wales.

## To Building Contractors, Constructional Engineers, Joiners and Others.

of HERBERT JOYCE & SONS, LTD., BLACKPOOL.

### IMPORTANT SALE BY AUCTION

ON WEDNESDAY, 15th APRIL, 1953.

G. F. SINGLETON & CO.

have received instructions from the Receiver, J. Noel Haworth, Esq., F.C.A., to offer for SALE BY AUCTION on the premises (subject to Conditions of Sale and unless previously sold by private treaty), at 11 a.m. precisely:

LOT 1.—THE CONTRACTOR'S STORE YARD containing 1,555 sq. yd. Land, situate Press Street off St. David's Road North, St. Anne's-on-Sea, with frontage of 104 ft. to St. Leonard's Road, Brick-built Office and Mess room 17 ft. 10 in. x 21 ft. 6 in. x 9 ft. 6 in. "Hodgson & Stead" 10-ton Weighbridge and Motor House.

LOT 2.—MODERN SINGLE-STORY BRICK FACTORY BUILDING (occupied as Garage and Workshop), 79 ft. x 31 ft. 3 in. on 580 sq. yd. Land adjoining Lot 1. Petrol Pump with 500-gallons tank.

LOT 3.—THE PRECAST CONCRETE WORKS with Moulding Shop and Drying-shed Buildings, 111 ft. x 19 ft., and 849 sq. yd. Land, situate Press Street, as aforesaid; Swivel-jib Crane and Moulds for Bus Shelters, Fencing, Kerbs, Window Frames.

To be followed at 12 noon by a Piecemeal Sale of the

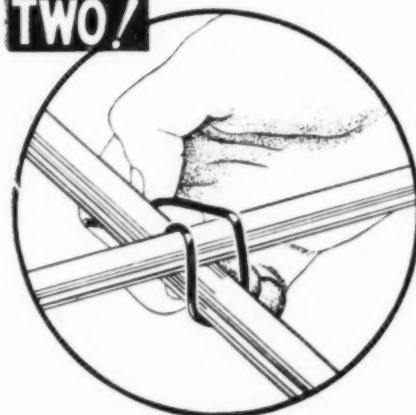
#### CONTRACTOR'S PLANT & STORES

including two Cabins, five Concrete Mixers 5/3½ to 14/10 capacity, three Mortar Mills, Concrete Vibrator, Stone Crusher, 5-cwt. Winch, Portable Crane, "Morris" Electric Hoist (new), Lifting Tackle, two Circular Saws, five Various Pumps, Planks, Ladders, Scaffolding and Fittings, Air Compressor, Road Breakers, Hammers, Diggers, Excavator, Mixer and Dumper Spares, Benches and General Stores and Equipment, "Commer" 4½-ton Wagon, "Commer" 10-cwt. Van, and "Ford Anglia" Saloon.

The Premises and Plant will be open for inspection on April 13th and 14th or earlier by appointment

Catalogues and further particulars may be obtained from the Auctioneers at Lloyds Bank Buildings, 53 King Street, Manchester 2 (Tel. BLA 2264/5), and 9 Richmond Terrace, Blackburn (Tel. 7722/3); from the Receiver, J. Noel Haworth, Esq., F.C.A., Messrs. Lysons, Haworth & Sankey, 71 King Street, Manchester 2 (Tel. DEA 2083/4); or the Solicitors, Messrs. Lonsdale & Co., 349 Clifton Drive North, St. Anne's-on-Sea (Tel. 65).



**ONE...****TWO!**

## 'STABIL' BINDERS

ARE GREAT LABOUR SAVERS

In one simple action they fix reinforcing rods as though welded. No slipping. No "fiddling" with wire. No tools to get mislaid. Any workman can use them. Made in all sizes for binding  $\frac{1}{8}$ -inch up to  $1\frac{1}{4}$ -inch rods. Give "Stabil" Binders a trial and judge for yourself.

- SEND TO-DAY for demonstration samples and prices.

### HUNTLEY & SPARKS LTD

DE BURG RD., S. WIMBLEDON, S.W.19

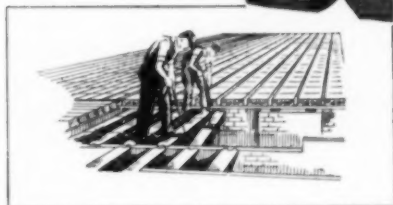
Phone: Liberty 2446



↑  
Easily adjustable up to 15 span by patent Telescopic system.

↑  
Triangular form gives maximum strength & minimum weight, making for speedy manipulation.

Strong buttressed bearing.



No timber is required, no carpenters' workshop on site. No obstruction beneath. For solid Concrete or Hollow Tile floor and roof construction. Instantly-adjustable up to 15 ft., adaptable for larger spans. Invaluable also for repair work. On hire from stock. Write or 'phone.

**TRIANCO LTD. (D. 26)**

Imber Court, East Molesey, Surrey

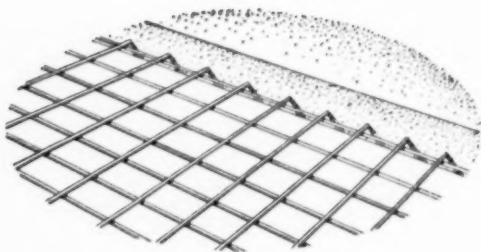
'Phone: Emberbrook 3300 (4 lines)



## ***Straight Facts on Twisteel . . .***

### **FABRIC AND BARS**

The use of hard-drawn wire in Wireweld fabric and of cold-worked Twisteel bars can save 30% in weight of steel and 15% in cost. Handling and fixing costs are lessened by the decreased weight.



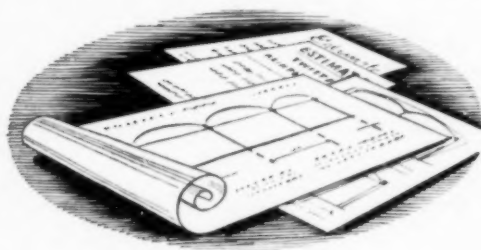
### **DESIGN**

Twisteel Engineers are dealing regularly with the design of all types of orthodox reinforced concrete structures as well as Barrel Vault Roofs and prestressed concrete. A special study is made of all new developments and modern techniques.



### **TECHNICAL SERVICE**

Twisteel will submit proposals including preliminary drawings for the design of any reinforced concrete structure, accompanied by a quotation which covers design, working drawings, calculations, schedules and reinforcement. These preliminary drawings and quotations are free and involve no obligation.



## ***TWISTEEL*** REINFORCEMENT LIMITED

LONDON: 43 UPPER GROSVENOR STREET, W.1. Telephone: GROsvenor 8101 and 1216

BIRMINGHAM: ALMA STREET,

SMETHWICK, 40. Telephone: SMethwick 1991

MANCHESTER: 7 OXFORD ROAD, MANCHESTER, 1. Telephone: ARdwick 1691

GLASGOW: 19 ST. VINCENT PLACE, GLASGOW, C.1. Telephone: CIty 6594

### Stable Concrete Mixtures.

IN Bulletin No. 24 of the Swedish Cement and Concrete Research Institute a report, in English, is given of investigations of stable concrete mixtures. This term is used to describe mixtures the deformability of which remains constant during a reasonable period of consolidation. If the deformability decreases as the period of consolidation increases segregation occurs, while a marked increase in deformability indicates poor workability with the risk of inadequate compaction. Various methods of stabilising a mixture are discussed, including the effects of the addition of resins, and are illustrated by examples from practice.

A device for measuring the deformability has been developed in which the free natural oscillation of a system is damped by the concrete, the damping increasing as the deformability becomes lower. The oscillating system (*Fig. 1*) consists of a vertical torsional shaft (1) the upper end of which is clamped to the frame and the lower end coupled to the concrete by means of the device (2). The concrete is filled into the container (3) and bolted to the vibrator (5). The frequency of

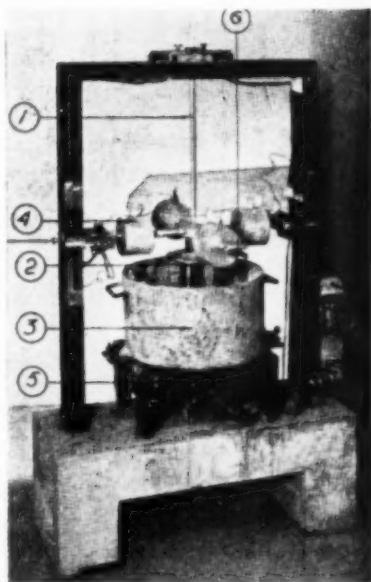


Fig. 1.

## STEEL TRENCH SHEETING

(Regd. design  
No. 850839)

**Prompt  
Delivery**

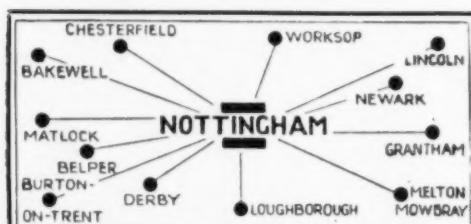
For the temporary lining of trenches and foundations. *Prices and full particulars on application to:—*

**DORMAN LONG & CO. LTD., SHEET DEPT.  
AYRTON WORKS, MIDDLESBROUGH**

London Office: Terminal House, 52 Grosvenor Gardens, S.W.1

# DORMAN LONG

oscillation of the shaft is controlled by the weights (4) attached to the cross-arms of the shaft. The measurements can be made during vibration or while the concrete is at rest. The oscillation is initiated by an instantaneous impulse produced by discharging capacitor batteries through electromagnets fixed at the ends of one of the cross-arms and is recorded by the plate (6) which screens off part of a cone of rays from a projector before the rays reach a photo-electric cell. The variations in the current produced by the cell are transmitted to an oscillograph and are recorded on a film.



## Trent Gravels

**10,000 tons per week**  
Washed & Crushed  $1\frac{1}{2}$  in. to  $\frac{1}{4}$  in.

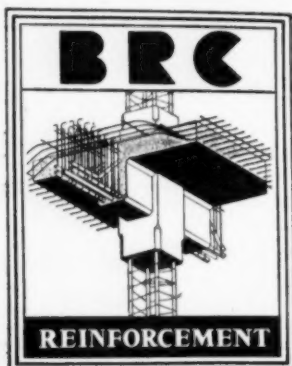
We are the leading suppliers of high-class concrete aggregates in the area shown above. Prompt deliveries guaranteed and keen competitive prices quoted. Send for samples and prices.

## TRENT GRAVELS LTD

ATTENBOROUGH

NOTTS

Telephone: Beeston 54255.



## CONCRETE

### DATA FOR PRICING REINFORCED CONCRETE.

#### Materials.

(Delivered in London area.)

**AGGREGATES** (per cu. yd.).—Washed sand, 21s. 9d. Clean shingle:  $\frac{1}{2}$  in., 18s. 5d.;  $\frac{3}{4}$  in., 21s. Pit ballast, 20s. 11d.  
**CEMENT** (per ton, delivered at Charing Cross).—Portland cement, 6 tons and upwards, 91s. 1 ton to 6 tons, 102s. Paper bags and non-returnable jute sacks included. Rapid-hardening Portland, 8s. above ordinary Portland. Aquacrete and 417, 32s. 6d. above ordinary Portland; paper bags included. Colorcrete (buff, red, and khaki), in 6-ton loads, 134s. 6d.; paper bags included. Snowcrete, £12 13s. 6d., inc. paper bags. "Super-Cement," 32s. 6d. per ton above ordinary Portland cement; paper bags included. High-alumina cement, 1 ton and upwards, 280s. per ton. Snowcem paint, 71s. per cwt. inc. containers.  
**SHUTTERING**.—For prices of timber, refer to S.R. & O., 1949, No. 1079 (price 1s. 1d.) and No. 94 (price 5d.) issued by H.M. Stationery Office.  
**REINFORCEMENT**.—Mild steel bars, B.S. 785 (per cwt.);  $\frac{1}{2}$  in. to 2 $\frac{1}{2}$  in., 40s.  $\frac{1}{4}$  in. to  $\frac{1}{2}$  in., 41s. 6d.  $\frac{3}{4}$  in., 42s.  $\frac{1}{2}$  in., 43s. 6d.

#### Materials and Labour.

(Contracts up to £5000. Inc. 10 per cent. profit.)

#### PORTLAND CEMENT CONCRETE, 1 : 2 : 4.—

Foundations, 2s. 3 $\frac{1}{2}$ d. per cu. ft. Columns, 3s. 2d. per cu. ft. Beams, 2s. 11d. per cu. ft. Floor slabs 4 in. thick, 8s. 4 $\frac{1}{2}$ d. per sq. yd.; Do., 5 in., 10s. 6d.; Do., 6 in., 12s.; Do., 7 in., 14s. 1d. Walls 6 in. thick, 13s. 5 $\frac{1}{2}$ d. per sq. yd. Add for hoisting above ground level 3s. 7d. per cu. yd. Add for rapid-hardening Portland cement 2s. 6d. per cu. yd.

**REINFORCEMENT**.—Mild steel bars (B.S. 785), including cutting, bending, fixing, and wire (per cwt.)— $\frac{1}{2}$  in. to  $\frac{1}{4}$  in., 70s. 3d.  $\frac{3}{4}$  in. to  $\frac{1}{2}$  in., 64s. 6d.  $\frac{1}{2}$  in. to 2 $\frac{1}{2}$  in., 59s.

#### SHUTTERING AND SUPPORTS.—

Walls, 201s. per square.

Floors (average 10 ft. high), 186s. 6d. per square. In small quantities, 2s. 5 $\frac{1}{2}$ d. per sq. ft.

Columns, average 18 in. by 18 in. (per sq. ft.), 2s. 10d.; in narrow widths, 3s. 7d.

Beam sides and soffits, average 9 in. by 12 in. (per sq. ft.), 2s. 9d.; in narrow widths, 3s. 3d.

Raking, cutting, and waste, 5 $\frac{1}{2}$ d. per lin. ft.

Labour on splays, 27d. per lin. ft.

Small fillets to form chamfers, 5 $\frac{1}{2}$ d. per lin. ft.

#### Wages.

The rates of wages on which the above prices are based are: Carpenters and joiners, 3s. 8d. per hour (carpenters 2d. a day tool money); Labourers, 3s. 2 $\frac{1}{2}$ d.; Men on mixers and hoists, 3s. 4 $\frac{1}{2}$ d.; Bar-benders, 3s. 5d.

This column is specially compiled for "Concrete and Constructional Engineering," and is strictly copyright.

April, 1953.

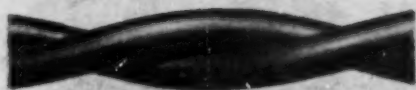
# Isteg makes steel go f-u-r-t-h-e-r

At this time of acute steel shortage, the fullest value must be obtained for every ton of steel used in building. Isteg steel bars ensure this in the field of reinforced concrete design. These twin twisted cold worked bars conforming to B.S.S. 1144:1943 can be used at tensile stresses of up to 30,000 lbs per sq. inch—50% higher than those permitted for mild steel. Apart from a considerable reduction in costs, this means a saving of one in every three tons of steel used. And this economy is coupled with safe and efficient reinforcement.

So, when you build in concrete—remember



## ISTEG



## STEEL

ISTEG STEEL PRODUCTS LTD. (SALES), 43, Upper Grosvenor Street, London, W.1. Telephone Grosvenor 1216

Isteg is manufactured by Guest Keen & Nettlefolds (Cwmbran) Ltd., Cwmbran. McCall & Co. (Sheffield) Ltd., Templeborough Sheffield. The United Steel Companies Ltd., Sheffield and Isteg Steel Products Ltd.

Every  
Reinforced  
Concrete Road  
is a contribution  
to national  
economy



ROAD REINFORCEMENT FABRIC

THE BRITISH REINFORCED CONCRETE ENGINEERING CO. LTD., STAFFORD  
*London, Birmingham, Bristol, Leeds, Leicester, Manchester, Newcastle, Cardiff, Glasgow, Dublin, Belfast*

M-W, 690

---

Published by CONCRETE PUBLICATIONS LTD., 14 Dartmouth Street, London, S.W.1. Telephone: Whitehall 4581  
Printed by BUTLER & TANNER LTD., The Selwood Printing Works, Frome and London